



SA80 ASSAULT RIFLES

NEIL GRANT



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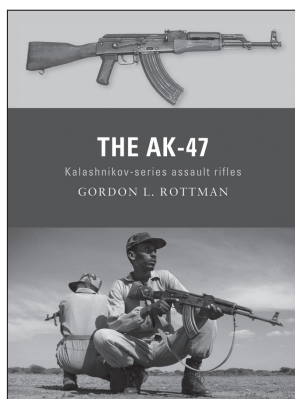
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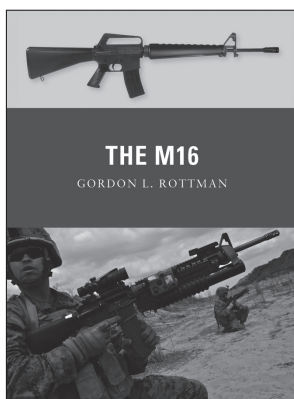
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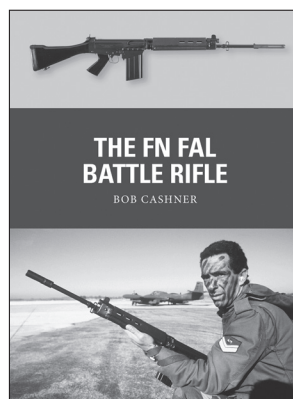
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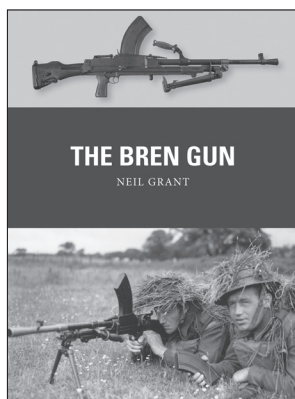
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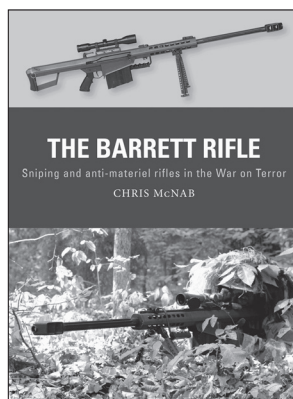
WPN No: 27 • ISBN: 978 1 78096 903 9



WPN No: 28 • ISBN: 978 1 78200 082 2



WPN No: 38 • ISBN: 978 1 4728 0734 2



WPN No: 45 • ISBN: 978 1 4728 1101 1



SA80 ASSAULT RIFLES



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Series Editor Martin Pegler

This electronic edition published in 2016 by Bloomsbury Publishing Plc

First published in Great Britain in 2016 by Osprey Publishing,
PO Box 883, Oxford, OX1 9PL, UK
1385 Broadway, 5th Floor, New York, NY 10018, USA
E-mail: info@ospreypublishing.com

Osprey Publishing, part of Bloomsbury Publishing Plc

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A CIP catalogue record for this book is available from the British Library

Print ISBN: 978 1 4728 1104 2

PDF ebook ISBN: 978 1 4728 1105 9

ePub ebook ISBN: 978 1 4728 1106 6

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Dedication

This book is dedicated to Arfon Williams (Wil 71), formerly of the Royal Regiment of Wales, who has been a good friend to my father.

Acknowledgements

The author and editor would like to thank the staff and trustees of the Small Arms School Corps weapons collection for their invaluable assistance in the preparation of this book.

Editor's note

Metric measurements are used in this book. For ease of comparison please refer to the following conversion table:

1km = 0.62 miles
1m = 1.09yd / 3.28ft / 39.37in
1cm = 0.39in
1mm = 0.04in
1kg = 2.20lb
1g = 0.04oz / 15.43 grains

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Front cover, above: An L85A1 Individual Weapon with an L3A1 Bayonet fitted. (Author's Collection)

Front cover, below: British troops armed with L85A1 Individual Weapons, wearing respirators and protective NBC suits during chemical warfare training just prior to the 1991 Gulf War. (© IWM GLF 400)

Title page: A soldier from 23 Engineer Regiment keeps watch with an L85A2 in Afghanistan in 2011. The Magpul polymer magazines are stored upside down in his webbing, with loops fitted to the bases for quick extraction. (MOD © Crown copyright 2011)

Artist's note

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INTRODUCTION

The SA80 is among the most controversial small arms adopted by a major power since World War II. Strictly speaking, the term ‘SA80’ refers to the whole ‘Small Arms for the 1980s’ programme, including the L85 Individual Weapon (IW, as the British Army termed the rifle version), L86 Light Support Weapon (LSW), L22 Carbine and L98 Cadet Rifle. In practice, however, the term usually refers to the rifle version.

On paper, the concept looked excellent. The IW would replace both the 9×19mm Sterling submachine gun (SMG) and the 7.62×51mm Self Loading Rifle (SLR), while the LSW would replace those examples of the L4A4 Light Machine Gun (essentially re-barrelled World War II-era Bren guns) still remaining in service and most examples of the L7 General Purpose Machine Gun (GPMG), leaving only a few of the latter in use in specialized roles. The two new weapons would have a high degree of commonality, dramatically reducing the number of spare parts required in



The main weapons of the SA80 system – the L85A2 Individual Weapon (below) and L86A1 Light Support Weapon (above). The cocking handle changed from the original round type on the A1 weapon to a curved one on the updated A2 weapon. (Author's Collection)

the supply chain. Their adoption would also simplify infantry training, since anyone familiar with one of the weapons would automatically be able to use the other. Meanwhile, advanced design features would result in the new weapons being more compact than anything else available – an obvious advantage given the British Army's preoccupation at that time with mechanized warfare against Warsaw Pact forces in Central Europe and with urban



patrolling in Northern Ireland. Even better, the new weapons and their ammunition would be significantly lighter than the designs they would replace, enabling soldiers to carry more ammunition despite the extra weight of the body armour coming into service at the same time as the new weapons.

The reality proved less rosy. The British Army actually found itself fighting very different wars from those it had anticipated, and weapons designed for mechanized combat in Europe proved less suitable for dusty desert environments. Some felt that the older and more powerful 7.62mm rounds would have penetrated the thick mud-brick walls of Afghan compounds better than their lighter 5.56mm replacements. The compromises required to keep the LSW compatible with the rifle version proved incompatible with the qualities needed from a good machine gun, and combat experience led to the GPMG making a comeback. Worse, corner-cutting in design and manufacture led to problems of poor reliability; and the reluctance of the Ministry of Defence (MoD) to admit that the problems existed, and their tardiness in rectifying them, saddled the weapon with a poor reputation that damaged troop confidence and hindered any significant foreign sales. The problems with the SA80 became so notorious that they became a long-running scandal for the press to exploit. Serious consideration was even given to simply scrapping the weapon and buying a foreign design, rather than rectifying the problems.

Whatever one's opinion of the SA80 family, it has undoubtedly been a significant weapon, albeit not always in a positive sense. It has armed almost every British soldier for the last three decades, and will continue to do so for at least another decade, making it a notably long-serving weapon. It has been involved in the heaviest and most sustained fighting British troops have experienced since the Korean War in the early 1950s, including the First and Second Gulf Wars, the Iraqi insurgency that followed, and the long campaign in Afghanistan. It has led to the most significant changes in British small-unit organization since World War II, with consequent effects on tactics and doctrine. Finally, although its replacement has not yet been selected, the SA80 will almost certainly be the last wholly British-designed and -built rifle issued to the British Army.

A soldier from The Royal Regiment of Fusiliers in Iraq. It is ironic that almost all of the SA80's combat use to date has been in desert conditions for which it was not designed. (Cody Images)



DEVELOPMENT

A new rifle for a new era

THE EM-2 PROJECT

Armies entered World War II with rifles firing powerful full-bore cartridges, such as the German 7.92×57mm, the British .303in (7.7×56mm) and the American .30-06 (7.62×63mm). All were hard-hitting rounds designed for combat at relatively long ranges, with consequently powerful recoil. They could be fired from semi-automatic rifles such as the US M1 Garand or German Gew 43, and made excellent machine-gun rounds. Any weapon light enough to be issued to every infantryman would be uncontrollable when firing such rounds on full-automatic, however. As a result, the war years saw the high point of the SMG, firing pistol cartridges such as the 9×19mm Parabellum. However, although these weapons provided more or less controllable automatic fire, they were short-ranged and lacked the hitting power of the rifle. Moreover, German studies during the war showed that most infantry combat took place at ranges of less

The EM-2 rifle. Although many of the design concepts of this bullpup design reappeared in the SA80 programme, the SA80 was neither directly based on nor developed from the EM-2. (Author's Collection)



than 300m, so that much of the theoretical range of the standard rifle round was simply wasted.

The Germans shortened the case of their 7.92×57mm cartridge to create the 7.92×33mm *Kurz* (short) round, and designed a radical new weapon – the StG 44 – around it. This was the first ‘assault rifle’; a select-fire weapon firing an ‘intermediate’ cartridge with recoil low enough for the weapon to be controllable on automatic and feeding from an SMG-style box magazine. It was intended to replace both the bolt-action Kar 98k rifle and the MP 40 SMG.

The British Army was influenced by similar research when it wanted to replace the rather elderly Lee-Enfield bolt-action rifle. However, the ‘Ideal Calibre Panel’ set up immediately after the war felt that while the basic idea of a shorter round was sound, the Germans had shortened their 7.92mm round too much, and the cartridge could be a little more powerful and still remain controllable for automatic fire. They were not alone in this belief: even the Soviet AK-47, which followed the design of the StG 44 quite closely, made use of a longer 7.62×39mm cartridge. The British eventually settled on a .276in (7×43mm) cartridge as the ballistic optimum, though it was known as the ‘.280’ to avoid confusion with several .276in cartridges tested in Britain and the United States before the war. They then designed a pair of radical weapons to fire the new round. Both were capable of selective fire (i.e. single-shot or full-automatic) from a 20-round box magazine, and had three radical features besides the new cartridge.

First, they were the first major weapons to use the ‘bullpup’ layout, wherein the magazine and action sat behind the trigger, rather than ahead of it. This allowed the weapon to be much shorter overall, while keeping the same barrel length. Secondly, they were designed as ‘in line’ weapons. With a conventional rifle, the line of the barrel was higher than the line of the stock. This allowed the user to look along the barrel to sight the weapon, but also meant that recoil force when a cartridge was fired pushed the weapon both backwards and upwards. An ‘in line’ weapon placed the barrel and top edge of the stock in a straight line, so that the recoil force pushed straight backwards, with minimal muzzle climb. This was an excellent characteristic for an automatic weapon – and later used on the American M16 series, for the same reason – but it meant that the sights had to be raised above the barrel by fitting them atop a carrying handle. This in turn meant that the user exposed more of himself when firing over cover. Thirdly, both weapons were fitted with optical sights as standard, rather than simple ‘iron’ sights.

The short-lived EM-1 (‘Experimental Model 1’) used a roller-locked mechanism and was made from metal pressings to save cost. Both were new technologies in the UK at that time, however. The British thus preferred the EM-2, designed around conventional gas operation and made using

British soldiers armed with the newly issued EM-2 rifle and its predecessor, the Lee-Enfield No. 4, 1951. (Photo by Keystone-France/Gamma-Keystone via Getty Images)



traditional machining techniques, which were more expensive but better understood. The EM-2 did well in trials in both Britain and the United States in 1948–50; but the US military believed that aimed shots at longer ranges would remain important in future combat, regardless of evidence to the contrary. They therefore felt that the British .280in round was underpowered and preferred their own 7.62×51mm round, which was effectively just a slightly shortened .30-06 cartridge. The British and Canadians (who also favoured the EM-2) sought a compromise solution, producing several EM-2 prototypes chambered for somewhat longer cartridges. The United States remained insistent that their own 7.62×51mm round was the lightest they would accept, however, despite British arguments that rifles chambered for this cartridge would not be controllable on automatic.

The EM-2 was briefly adopted by Britain's Labour government as the 'Rifle, Automatic, No. 9 Mk 1' in 1951, but trouble was looming. One of the key tenets of the 1949 NATO alliance was standardization of equipment, and especially ammunition. The US Ordnance Department made it clear that they would not adopt the .280in round, however; and when Winston Churchill and the Conservative Party returned to power in October 1951, the new British government decided that standardization with the United States was the most important thing, and reversed the previous government's decision to adopt the EM-2 before it was issued to the troops. Instead, the British adopted a semi-automatic-only version of the Belgian FN FAL rifle in 1954, chambered for the US 7.62×51mm NATO round. This weapon became the L1A1 SLR and served the British Army well for 30 years.

As the British had warned, the 7.62mm rifle adopted by the United States – the M14 – was quickly found to be uncontrollable on automatic, while experience in the jungles of Vietnam demonstrated that a shorter, lighter cartridge would have been preferable after all. In a terrible irony, the United States itself quickly abandoned the powerful cartridge it had effectively forced the British – and the rest of NATO – to adopt, in favour of the M16 rifle and its 5.56×45mm round.

The L1A1 SLR was a reliable weapon respected by its users, but was notably long, as this comparison with an L85A1 IW shows. (Author's Collection)



PRELIMINARY STUDIES (1969–71)

In one sense, the EM-2 was a dead end. Many of its design concepts reappeared in the late 1960s, however, when the British Army began looking for a possible successor to the SLR. The latter had served well in a number of small ‘end of Empire’ campaigns, and was generally popular among the troops; but it would reach the end of its economic life in the 1980s, by which time any replacement weapon needed to be developed and ready to enter service. Moreover, with the Army focused on armoured warfare in West Germany, the long (114cm) SLR was an awkward weapon for troops expecting to fight from armoured personnel carriers. Meanwhile, the lack of an automatic capability kept the Sterling SMG (a World War II design) in front-line service long after most other armies had given up such weapons. With even the Americans now accepting the logic of the short assault-rifle cartridge and using the 7.62×51mm round only in machine guns, the way forward seemed obvious – the British Army wanted an assault rifle, too.

Previous weapon procurements had generally involved competitive tests to select the best weapon from those available. This time, it seemed taken for granted that the new weapon should be designed in Britain, rather than bought from another country. Despite generally positive experiences with the M16 rifles the British Army had purchased for special applications, there was little systematic attempt to evaluate what was already available on the open market. The Royal Small Arms Factory (RSAF) at Enfield was selected to design the weapon the Army needed, and began preliminary studies for a potential replacement cartridge and rifle in 1969. These studies investigated calibres from 4.5mm to 7.62mm with an effective range of 300m to 600m. Caseless rounds (as later used in the German G11 rifle) and very small-calibre, very high-velocity flechette projectiles were briefly considered, but RSAF Enfield did not believe either could be developed and fielded within the timescale required.

Attention initially centred on a 6.25×43mm round – effectively, a necked-down version of the .280in round of the EM-2. This appeared to give similar penetration to that of the 7.62×51mm NATO round out to 600m, while having a low enough recoil to be controllable during automatic fire. By 1970, the focus had changed to a slightly smaller round (4.85×44mm) created by trimming and necking down standard 5.56×45mm NATO cartridge cases, before finally settling on a slightly longer (4.85×49mm) cartridge for both the IW and LSW. The study identified four possible configurations for the weapons to fire the new cartridge:

- (1) Normal configuration (i.e. with magazine and action ahead of the trigger) and SLR-style dropped butt.
- (2) Normal configuration and M16 style in-line butt for better control of recoil, at the cost of raising the sight line.
- (3) Bullpup configuration (i.e. with magazine and action behind the trigger) and dropped butt.
- (4) Bullpup configuration with in-line butt.

A compromise solution – fitting a conventional weapon with a folding stock – was dismissed because of concerns that such a stock would not be rigid enough for accurate shooting. This was a critical decision. Either of the first two options – those featuring a conventional layout – could be achieved by simply re-barrelling an existing design, or at least using it as a starting point, and would thus reduce risk and cost. Perhaps inevitably, given the history, the study opted for a bullpup configuration. This gave the benefit of a more compact weapon; however, since there were no bullpup weapons in service anywhere, it inevitably meant developing a new design from scratch, with obvious increases in development costs and risks.

Several wood-and-metal mock-up weapons were produced, to give an impression of what the eventual weapon designs might look like, but no actual prototypes were built during this phase. Existing weapons – including Stoner 63 and Armalite AR-18 assault rifles – were modified for firing tests of the new cartridges and to demonstrate various design concepts.

The preliminary study had also been asked to look at the future for the squad LMG. The terms of reference potentially allowed the selection of a larger calibre such as 7.62mm NATO for this, but instead the study advocated using a version of the IW, fitted with a bipod and a longer, heavier barrel to act as a ‘light support weapon’. On one level, this made good sense. A new LMG would be necessary anyway, and having all the weapons in the infantry section firing the same cartridge simplified logistics and allowed ammunition to be redistributed within the section if necessary.

The two weapons were intended to have an 80 per cent commonality of parts, bringing down the cost of manufacture for both weapons because only one set of drawings, masters, etc. would be needed, and reducing the number of spare parts required. Training would also be simplified, with infantrymen only needing to learn how to use, strip and maintain a single design, rather than a separate rifle and machine gun. It was not a revolutionary idea: the Warsaw Pact had adopted the RPK – effectively a version of their AK-47 assault rifle with a longer, heavier barrel and a bipod – as their standard LMG some years before. There were tensions between designing a good rifle and designing a good machine gun, however. Equally, the designers had to balance maximum commonality of design with optimizing the two weapons for their particular roles.

First, rifles are generally designed with accuracy in mind, and fire from a closed bolt. This means that cocking the action brings the bolt back to strip a cartridge off the magazine, then lets it go forward again to chamber the round. This round remains in the chamber until the trigger is pulled, when the cartridge detonates and the bolt moves backwards to eject the spent cartridge, strip the next round from the magazine and chamber it ready to repeat the sequence.

Pure automatic weapons (SMGs and machine guns) usually fire from an open bolt, however. Here, cocking the action brings the bolt back and holds it there. The chamber remains empty until the trigger is pulled, at which point the bolt runs forward, picks up a round from the magazine, chambers and immediately fires it. The detonation of the cartridge sends the bolt back, where it is caught and held, ready to go forward the next time the trigger is pulled, repeating the sequence. Open-bolt designs are

less accurate, since the mass of the bolt slamming forward when the trigger is pulled moves the point of aim slightly, but they leave the barrel and chamber empty and open to the air for cooling between bursts. This latter feature is not important for a rifle, with its low rate of fire, but it becomes very important with machine guns because the chamber quickly heats up during automatic fire – sometimes to the point where chambered cartridges can ‘cook off’ and fire spontaneously.

Secondly, most NATO machine guns (including the British Bren and GPMG) have been equipped with quick-change barrels. The advantages are obvious: as the barrel starts to overheat from sustained automatic fire, the gunner can simply swap it out and continue firing using the spare barrel. Meanwhile, the original barrel is put aside to cool, allowing the machine gun to maintain a high rate of fire for a prolonged period. Fitting the LSW with a quick-change barrel required changes to the receiver, however, thus reducing commonality with the rifle. On the other hand, if it was fitted with a fixed barrel, its sustained-fire capability would inevitably be reduced.

Thirdly, the LSW would use the same 20- or 30-round box magazine as the rifle. This was not automatically a bad decision – the magazine-fed World War II-era Bren gun had been successful enough – and indeed box magazines had several advantages over belt feed. They were less likely to pick up contamination in muddy or snowy environments (which is why the Royal Marines often preferred the older Bren to the newer GPMG for Arctic deployments) and they were much easier to use on the move. It also meant that the riflemen and LSW gunners in the section could swap ammunition among themselves, even in action, without having to reload rounds from belts to magazines or vice versa. Using box magazines inevitably reduced the practical volume of sustained fire that could be achieved, however, and belt-fed machine guns had been preferred since World War II for exactly that reason. The obvious solution was to use a large-capacity drum that fitted into the same magazine well as the standard box; the Soviet RPK used a 75-round drum, for instance. While that worked for conventionally laid out weapons, however, the magazine well of a bullpup weapon was in the butt, making the use of a drum magazine awkward.

Although the designers were aware that all of these choices would reduce the weight of fire the proposed LSW could put down, their solution was simple. Whereas the weight of a conventional machine gun and its ammunition meant that each section could only carry one such weapon, the same section would be able to carry two of the new weapons and their lighter ammunition. Although each LSW would produce less firepower than a conventional machine gun, having two of them meant that the firepower of the section as a whole would actually be increased.

The SA80 was not the first 5.56mm rifle in British service; the armed forces bought a considerable number of M16s in the 1960s and 1970s, which were used by elite forces and units deployed for jungle warfare, such as this Royal Marine of the Mountain and Arctic Warfare Cadre in the mountains above Port Stanley during the 1982 Falklands War. (© IWM FDK 2032)



INITIAL FEASIBILITY STUDIES (1972–74)

Based on the results of the preliminary studies, the MoD began to develop a General Staff Target (GST 3518) – effectively, a formal statement of what was required from a weapon system. Meanwhile, RSAF Enfield produced 12 test weapons, known as the ‘Double O’ series since their serial numbers ran from 001 to 012, to test the preliminary study concepts. The weapons were all based on a common bullpup design, and were fitted with 4× Sight Unit, Small Arms, Trilux (SUSAT) optical sights. All weapons were set up for right-handed use, though they could be converted for left-handed use by unit armourers. The design featured a 20-round box magazine released by a catch on the right-hand side of the body, and a push-through safety catch. The selector switch included a three-round-burst setting as well as the usual semi- and full-automatic settings. Since the muzzle of any weapon fired from the shoulder on automatic tends to climb sharply, this setting prevented ammunition being wasted by cutting off the burst after three rounds, before recoil pulled the weapon too far away from the point of aim. (A similar device was later fitted to the US M16A2, in response to infantrymen in Vietnam expending all their ammunition in ‘spray and pray’ bursts, rather than aiming.)

A wood-and-metal mock-up to demonstrate what a potential bullpup individual weapon might look like (bottom); and two conventional weapons – an Armalite AR-18 (middle) and Stoner 63 (top) – converted into bullpup configuration during the feasibility study. (Author's photograph, © Royal Armouries PR.10084, PR.5350, PR.5345)

The first six weapons (001–006) were 4.85mm IWs, firing from a closed bolt in both semi- and full-automatic modes. Weapon 007 was identical, but chambered for the 5.56mm NATO round used by the M16 and fitted with the ‘handbag’ sling used by the later ‘O’ series. Weapon 008 was fitted with an experimental 40mm grenade launcher under the barrel, to give a capability against area targets. Weapons 009–012 were 4.85mm LSWs, with a longer, heavier barrel and a rearward-folding bipod

fitted just ahead of the handguard. The four LSWs fired from a closed bolt on semi-automatic, but from an open bolt on automatic or three-round-burst. This preserved the best features of both, but at the price of a complex mechanism and reduced commonality.

Although the bullpup rifles looked radical from the outside, the mechanism bore a strong resemblance to that of the Armalite AR-18. Indeed, some of the internal components seemed to be straight copies, or even re-used Armalite components, leading to assertions that the design was ‘just a bull-pupped AR18’.



The AR-18

The 5.56mm Armalite AR-15 rifle was a radical design when it was adopted by the US Army as the M16 from 1965, but it required advanced materials and relatively complex tooling to produce. Armalite therefore developed the AR-18 as a simpler weapon, made mostly from steel stampings. It was a low-cost design intended for production in less-developed countries that wanted to adopt the 5.56mm cartridge, but had a more limited industrial base.

The AR-18 was a selective-fire 5.56mm rifle like the M16, but it used a conventional gas piston rather than M16-style direct gas impingement, in which propellant gas acts directly on the bolt carrier. Whereas the M16's buffer mechanism protrudes into the butt and prevents use of a folding stock, the AR-18's mechanism was fully contained in the receiver, allowing a side-folding stock to be fitted as standard.

The AR-18 was tested by the US Army in 1964 and the British Army in 1966. These trials found that its functioning was rather dependent on ammunition quality; and that although the basic design was sound, its reliability would need to be improved before it was acceptable as a service rifle. In particular, the British felt it performed poorly in the mud and sand tests.

Armalite produced only a few AR-18s itself, but licensed production to a Japanese company during 1970–74, and then to the Sterling Armaments Company in Britain during 1975–83. The Sterling factory was practically on RSAF Enfield's doorstep, and RSAF engineers visited several times to view the AR-18 production line. Although never adopted by any army, a number of AR-18s found their way into the hands of Provisional Irish Republican Army terrorists during 'the Troubles' in Northern Ireland.



A 5.56mm Armalite AR-18 rifle with telescopic sight. (Courtesy Rock Island Auction Company)

The feasibility study concluded that the 4.85mm ammunition exceeded the 300m effective range requirement set out for the IW, and just met the 600m requirement for the LSW. Based on these results, the MoD formalized GST 3518 as a General Staff Requirement (GSR) in 1974, defining the characteristics of the required weapon system. The new IW would replace the L1A1 SLR and L2A3 Sterling SMG, while the LSW would replace the L4A4 Bren and L7A1 GPMG. The new weapons would be shorter, lighter and handier, and their reduced ranges would not be a tactical disadvantage in the battle scenarios envisaged. They would simplify training, and reduce the soldier's load. The GSR noted that the LSW only had a limited sustained-fire capability; but any significant increase in rate of fire would require belt feed, which was incompatible with the requirement to use the same magazine as the rifle. The possibility of providing the LSW with a quick-change barrel to improve sustained-fire capability was noted, but not actioned.

THE IMPROVED 'O'-SERIES PROTOTYPES (1975–76)

RSAF Enfield now began to develop and improve the initial prototype weapons, intending to have refined weapons ready by the NATO ammunition trials, scheduled for 1977. The first phase involved construction of another 12 prototypes, known as the 'O' series since their serial numbers began with weapon 01. Although these were similar to the previous 'Double O' series, detailed differences included a redesigned trigger and pistol grip, and repositioning of the sling-attachment points to the top of the weapon to allow it to be carried in what the designers termed a 'handbag style'. The flash eliminator was modified to allow the weapon to fire NATO-standard 22mm rifle grenades, and the magazine release was moved from the right side of the body to the left – something that would cause problems later. Meanwhile, the selector switch was replaced by a rotary type with only two positions: single shot and automatic; the three-round-burst function of the 'Double O'-series weapons disappeared.

Of the 12 'O' prototypes, six were standard IWs, five of which were configured for right-handed use and one for left-handed use. Two extra IWs were built, one with flip-up emergency sights in case the SUSAT optical sight unit failed or was damaged, and the other with a stabilizing monopod beneath the barrel. Four LSW prototypes were constructed, two of which were right-handed models and one left-handed, all firing from closed bolt on single-shot and open bolt on automatic. The last of the four LSWs (also the twelfth and final 'O' prototype) was fitted with a quick-change barrel for improved sustained-fire performance, and a muzzle brake to reduce recoil rather than the standard flash eliminator. These modifications were rejected, however, since they increased both cost and weight while decreasing commonality with the IW – and commonality was a major selling point of the system. The improvement in sustained-fire capability was also relatively small, since the weapon remained magazine (rather than belt) fed.

Prototypes of the XL64 IW (below, with 20-round magazine) and XL65 LSW (above, with 30-round magazine). Note the bipod attachment halfway down the barrel on the LSW, and the SLR-style magazine release catch immediately behind the magazine well, rather than on the side. (Author's Collection)





A publicity photo of the XL64E5 IW and XL65E4 LSW experimental weapons, June 1976. Note that the bipod of the LSW is attached much closer to the handguard than on the production LSW. (Cody Images)

The Enfield Weapon System was unveiled to the press in June 1976, ahead of the NATO ammunition trials scheduled for the following year. The publicity material implicitly assumed that it would become the British Army's next infantry weapon system in due course, even though no formal acceptance – nor any trials – had taken place, and only a small number of essentially hand-built prototypes had actually been produced. The publicity material highlighted the innovative design of the Enfield weapons. It also emphasized the reduction in length and weight compared to the SLR and GPMG they would replace, while stating that although the detailed performance was 'classified', they were 'at least as effective as the current 7.62mm weapons over normal ranges and conditions' (quoted in Raw 2003: 37). Even the two photographs included in the press pack were carefully crafted to add to the image of modernity. In each case, the soldier holding the new weapon wore the latest equipment, including the new ballistic helmet, while his counterpart with SLR or GPMG was dressed in dated equipment and old-fashioned steel helmet.

THE XL64 AND XL65 SERIES (1976–77)

The weapons finally received formal service designations for the second phase of the feasibility study, which would finalize the design for the NATO ammunition trials. British weapon designations started with 'L' for 'Land Service', while experimental items were designated as 'XL' until they entered service. The standard right-handed version of the IW was thus designated as the XL64E5, while its left-handed equivalent was the XL68E2. Meanwhile, the LSWs became the XL65E4 (right-handed) and XL69E1 (left-handed). More prototypes would be needed for the NATO trials. In all, 36 IWs (33 right-handed and three left-handed, all firing from closed bolts) and 36 LSWs (32 right-handed and four left-handed, all still firing from a closed bolt on single-shot and open bolt on automatic) were produced.

These prototypes included several modifications compared to the previous 'O'-series weapons. A hinged ejection-port cover was fitted, to



The SA80 went through significant changes as it evolved from the XL64 prototype (bottom) to the initial L85 production weapon (middle) and then the modified L85A2 with the 2009 Operational Handguard (top). (Author's Collection)

prevent sand and grit entering the mechanism. The previous 'push-through' safety catch was replaced by a lever-type catch as used on the M16. The magazine release was moved once more, this time to a position behind the magazine where it could easily be accessed by both right- and left-handed users, but was unlikely to be activated accidentally. The 'handbag'-style sling was replaced with a more conventional one, and a slightly curved 30-round magazine appeared for the LSW, supplementing the straight 20-round version which remained standard for the IW. Only limited testing could be conducted before the NATO trials, but it was hoped

and expected that the Enfield Weapon System would do well in the latter, and would be adopted by the British Army with little further modification. As we shall see, this was not to be the case.

THE NATO AMMUNITION TRIALS (1977–79)

Although NATO had adopted the 7.62mm NATO round as its standard rifle cartridge, the United States had effectively switched to the 5.56mm M16 during the Vietnam War, and several other NATO countries had followed suit. While it was agreed that the 7.62mm NATO cartridge would be retained for vehicle machine guns and sniping rifles, where its power was essential, a new ammunition trial would be held from April 1977 to select a second, lighter round. This would then become the new NATO standard for rifles and LMGs. Although the NATO trials were intended to select a new cartridge, rather than a new rifle, the British team anticipated that the trials would be a good test of the performance of the new weapon.

Any hopes that the 4.85mm round might be adopted as the new NATO standard round appear naïve in retrospect. Many of the other countries – including the United States – had already made significant investments in adopting 5.56mm weapons, and would have been reluctant to change again unless any new round offered significantly improved performance. Other than Britain, only one country – West Germany – had submitted anything other than a 5.56mm round. The German offering was a very radical caseless 4.7mm round, which did offer very considerable advantages, being only half the weight of an equivalent conventional

round and considerably more compact. The technology was not sufficiently mature, however, and it had to be withdrawn from the trials after problems with rounds ‘cooking off’ in weapons after sustained fire. The British 4.85mm round performed better than some of the 5.56mm rounds, but not by enough to justify switching. The best overall performer was the Belgian SS109, a



5.56mm cartridge with a longer, heavier but more aerodynamic bullet than the existing US M193 cartridge, giving it improved range, stability and penetration. The SS109 was therefore adopted as the new NATO standard, though existing 5.56mm rifles could be adapted to use it simply by fitting replacement barrels with the correct rifling twist.

Leaving aside the fact that its 4.85mm cartridge had effectively been rejected, the NATO trials had identified several issues with the XL64 and XL65. The ten XL64 IWs used in the tests fired a total of 66,023 rounds, during which they experienced 679 ‘incidents’. While the XL64 was a new design, and had not benefited from years of troop experience – the American M16 had been in service for more than a decade at that point, and had seen extensive combat use in Vietnam – this ‘Mean Rounds Between Failures’ (MRBF) figure of only 97 rounds was surprisingly poor. The two most common causes of failure, accounting for around 500 of the 679 incidents, were either failures to extract and eject spent cartridge cases properly, or failures with the trigger mechanism and sear. The latter cause of failure manifested itself both as the weapon firing on automatic when set to single-shot, and as the trigger not returning to the normal position after being pulled, thus preventing further firing. In either case, the problem seemed to be caused by grit and dust entering the trigger mechanism – an issue that would recur throughout the weapon’s life.

With the original ‘in service date’ (ISD) of 1983 in danger of slipping, the post-trial appraisal in October 1979 acknowledged that while the basic concept was sound, modifications were needed to improve the reliability of the weapon. It also had to be redesigned to accept the new SS109 5.56mm round and an M16-type magazine, the latter having also been adopted as a NATO standard. Despite the work required, it was decided that User and Ordnance Board trials would begin in mid-1981, to prevent the ISD slipping further. As an interim, ten of the trials weapons (five IWs and five LSWs, all standard right-handed models) were converted to 5.56mm, to allow some testing to proceed while the redesign was in progress.

Comparing the XL65 LSW prototype (above) to the production L86A1 (below) shows how the controls changed over time. The magazine release moved from behind the magazine to the left side, and the lever-type safety catch above the pistol grip was replaced by a push-through type. (Author’s Collection)

THE XL70 AND XL73 SERIES (1980–84)

As a result of lessons learned from the NATO ammunition trials, three new weapons (the ‘Production Rifle’ or ‘PR’ series) were produced. These were still chambered for the 4.85mm round as an expedient to get them into production quickly; and they also went through a process of ‘Value Engineering’ (disparagingly referred to by the design team as ‘engineering by accountants’) to simplify manufacture and reduce the time to produce each weapon from ten hours to a more economically viable 7½ hours. This changed the rear body of the weapon significantly, to a wedge-shaped box of pressed metal, despite concerns that this configuration provided less support for the internal components. Other changes included making the flash eliminator a separate component rather than part of the barrel; using a cheaper method to manufacture the trigger mechanism; and adopting a modified gas system and a new (and cheaper) one-piece plastic handguard instead of the two-piece version used on previous weapons. The magazine catch moved to the left side of the weapon, this as a consequence of the way in which the new M16-type magazine locked into place. The safety also reverted to a push-through plunger.

One ‘PR’-series LSW was produced, by converting one of the three ‘PR’ IWs above, and fitted with a new forward-folding bipod. Testing of these weapons indicated that work was needed to resolve the outstanding problems, and it was agreed to delay the User Trials by three months, until October 1981. These ‘PR’ weapons were followed by the main production of the XL70 series, chambered for the 5.56mm cartridge. A total of 51 IWs were built, in both right-handed (XL70E3) and left-handed (XL78E1) configurations. In addition, 34 XL73E2 LSWs were produced, all in right-handed configuration; and since far fewer LSWs would be required, it was decided that no left-handed conversion kits would be produced. Externally, the main difference from the ‘PR’ weapons was a welded-on extension to the magazine housing, which protruded beneath the weapon’s body to give more support to the magazine. Internally, the gas system was modified, the bolt carrier and recoil guide-rod assembly was redesigned, and the extractor was replaced with a new design. Although the LSW had originally been

intended to fire from a closed bolt on semi-automatic (for accuracy) and an open bolt on full-automatic (for better cooling), the XL73E2 fired from open bolt in both modes, significantly simplifying the mechanism.

As an experiment, one LSW was modified to fire from the closed bolt on both single-shot and full-automatic, using the trigger mechanism from an IW, and this ultimately became the preferred option. While firing from a closed bolt improved LSW accuracy, the problem of chamber overheating and the attendant ‘cooking-off’ problem – the reason the open-bolt option had been added in the first place – now returned, reducing the LSW’s sustained-fire capability.

An XL70E3 IW camouflaged with green tape and fitted with an image-intensifier night sight.
(Cody Images)



THE ORDNANCE BOARD AND ITDU TRIALS

The Ordnance Board trials were intended to identify technical problems for correction before series production, and ran in parallel with the User and Troop Trials. Weapons were put through a number of tests including mud baths, drop testing and sustained-fire reliability tests, as well as being exposed to extremes of heat and cold. The methodology used would be criticized later by the Cabinet Defence Select Committee, for being too ‘clinical’ and using environmental chambers rather than testing how the weapons would actually be used by soldiers. For example, the icing tests were conducted by spraying the weapons with water in a freezer, which failed to replicate the effects of wind-driven snow clogging every opening in the weapon when troops actually deployed with it to Norway. Reliability was defined by ‘Mean Rounds Between Failures’ (MRBF), with a target of 2,500 rounds for the IW and 8,000 rounds for the LSW; the latter figure was obviously very ambitious, since the LSW had essentially the same mechanism as the rifle. Failures were classified into three categories:

- (1) ‘Minor’ incidents could be rectified by the user employing the standard ‘Immediate Action Drills’, e.g. re-cocking the weapon to load a new cartridge after a misfire;
- (2) ‘Serious’ incidents could be rectified by the user but needed more action, e.g. by stripping and cleaning the weapon to remove excessive fouling;
- (3) ‘Critical’ incidents could not be rectified by the user, e.g. parts breakages.

The MRBF calculation counted only critical failures. While this was not intrinsically wrong – any MRBF target including the less serious categories would have necessarily been much lower – it did have adverse consequences. Since nothing except critical failures affected the MRBF target, the other categories were essentially ignored and little attention was paid to rectifying the causes, no matter how frequently they occurred. By contrast, troops in combat suffering stoppages every couple of magazines were unlikely to find this acceptable even if these were technically ‘minor’ incidents that did not affect the reliability target.

The MRBF calculation also led to a certain amount of manipulation as the LSW struggled to meet the reliability target. For instance, a fractured bolt was initially classified as a ‘critical’ failure. If a spare bolt was included in the tool wallet, however, the same incident immediately became something the user could theoretically rectify – no matter how unlikely in practice – and thus became merely a ‘serious’ incident

This Royal Marine of 45 Commando with his L85A2 camouflaged with self-adhesive white plastic is pictured during an exercise in Norway. (MOD © Crown copyright 2010)



which did not count toward the MRBF. Artificial as this may be, it is exactly what was recommended, and a complete replacement bolt was added to the LSW tool wallet for the trials. Once the MRBF target had been met, however, the standard contents of the wallet were quietly revised – and the spare bolt disappeared before issue.

The IW initially achieved an MRBF figure of 1,250, but this was ‘corrected’ to 2,500 by ignoring ‘critical’ failures caused by issues the design team believed could be eliminated by design changes before production; a rather optimistic way of conducting reliability trials. The LSW scored significantly better – 2,713 for rounds from an open bolt and 4,746 for shots from a closed bolt – but still fell well short of the target figure, even after correction. Both weapons were found to be very accurate in single-shot mode; but while the first round on automatic was generally on target, subsequent rounds were well off-target, particularly at longer range. This was inevitable to some extent, as muzzle climb on automatic will always push the weapon off-target. The effect was more severe than expected, however, especially for the LSW where the bipod should have stabilized the weapon. Rounds also started ‘cooking off’ after firing about 330 rounds at a rate of one per second – well above the rate at which a rifle would be fired, but not above that expected of a machine gun. Other problems included issues with the bipod catch and cracking of the bolt carriers.

The SA80 system was also assessed by the Army’s Infantry Trial & Development Unit (ITDU), in parallel with the Ordnance Board trials. The ITDU trials were not intended to assess reliability – that would be tested by the Ordnance Board – but to assess usability and effectiveness. For instance, the ITDU expressed concern that the LSW did not meet the requirement to deliver effective suppressive fire. Despite this, its final report indicated that ‘the IW proved itself to be a robust and reliable weapon that suffered few stoppages ... the majority of the problems previously noted have now been overcome’ (quoted in Raw 2003: 85).



A Royal Marine of 45 Commando during a multi-national exercise at the Jungle Warfare School, Ghana in 2013. (MOD © Crown copyright 2013)

THE XL85 AND XL86 SERIES

During the trials, the XL70-series weapons were replaced by the XL85E1 IW and XL86E1 LSW. These would effectively be the production build standard, and incorporated a number of changes. Only right-handed versions of both weapons were produced, the requirement for a left-handed version having been effectively dropped – a conversion kit was promised, but never materialized. The RSAF final report noted that the required MRBF for the LSW had still not been met, though the design team remained optimistic that this could be achieved. Overall, the acceptance meeting agreed to adopt the IW, and give limited approval for production of an initial tranche of 30,000 weapons. Concerns remained over the LSW's accuracy on automatic and its ability to deliver a sufficient weight of suppressive fire, however. Its adoption was therefore deferred until these issues could be resolved.

Deferring adoption of the LSW gave the Army significant problems. The remaining L4A4 Light Machine Guns could not be kept in service indefinitely, as stocks of spare parts were exhausted; and retaining the GPMG at section level would necessitate significant purchases to replace existing worn-out weapons. It would also mean that infantry sections would need both 5.56mm ammunition for the IWs and 7.62mm ammunition for GPMGs, thus complicating logistics.

Going back to the drawing board to design a new LSW that might meet the specifications more closely was not a serious option; it would take several years to develop a new weapon, and there was no guarantee that it would perform any better than the existing LSW. The preferred option was to allow RSAF Enfield a limited amount of time to rectify the problems. Meanwhile, the MoD would define subjective criteria (such as providing 'effective suppressive fire') more clearly, and indicate the minimum performance they would accept. Although this would require some compromise, the thinking was that this might be the best outcome for the Army if successful, as it retained the advantages of the original plan.

Finally, the MoD reviewed several foreign weapons that might fulfil

The SA80 was not the only bullpup rifle to be adopted. The Steyr AUG (top) was adopted by the Austrian armed forces in 1978, and has been bought by numerous other armies since then. The same receiver can accept any one of four interchangeable barrels – rifle, carbine, short carbine and a heavy squad automatic barrel with a bipod. It can even be converted to fire from an open bolt in the squad automatic role. The French armed forces adopted the FAMAS (middle) in 1978, replacing both the MAS-49/56 rifle and MAT-49 submachine gun. Both the FAMAS and the AUG are fitted with ambidextrous controls and easily converted at unit level to eject to either side for left- or right-handed use. By contrast, although a small number of left-handed XL70s were produced (bottom) the production SA80 could only be used by right-handed firers. (Author's Collection)





The revised LSW, with the rearward-folding bipod mounted closer to the muzzle and supported by an outrigger rail, demonstrating the firing position with the left hand on the rear grip below the butt. (Cody Images)

the LSW role, including the FN Minimi, the Heckler & Koch HK13 and the Steyr AUG. While adopting a foreign weapon would be politically embarrassing, especially since it would effectively mean writing off the development costs of the British LSW, it provided a fall-back in case RSAF Enfield failed to come up with something that satisfied the revised criteria. As none of the available weapons exactly met the GSR specification – by not having a single-shot capability, not using the same magazine as the IW, or whatever – this would also have required some compromise, as well as losing the advantages associated with commonality.

Under the redefined requirements, the LSW had to meet a rather lower standard for providing suppressive fire, while the accuracy requirements were heavily weighted towards single-shot performance, rather than automatic fire where the weapon did less well. Meanwhile, the weapon itself had been modified with a second pistol grip beneath the butt, for better control during automatic fire, and a butt strap to take the weight of the weapon in the prone position. The original LSW prototypes had a bipod mounted just ahead of the handguard. This was changed to a rearward-folding bipod, mounted much closer to the muzzle, giving a more stable platform and improving accuracy; however, this meant extending an outrigger rail out from the handguard to the muzzle to support the bipod, which increased weight.

With these changes, the LSW was finally adopted for service, and a contract for the first 175,000 weapons – now formally known as the L85A1 IW and L86A1 LSW – was awarded in June 1985. The first weapons were handed over in an upbeat and well-publicized ceremony in October 1985.



USE

Expectation versus reality

INTO SERVICE

Acceptance and troop trials

After acceptance, the new weapons went through troop trials in 1986–87 with several units deployed in a variety of environments. It was originally intended that all regular infantry battalions, the Royal Marines and the RAF Regiment would have changed over to SA80 by 1987, and all regular Army forces by 1990. The RAF was to re-equip in 1991. Territorial Army (part-time reservist) units would be re-equipped 1991–93, with priority going to units intended to reinforce the British Army of the Rhine, the forces permanently deployed in West Germany to counter any Soviet invasion during the Cold War. The Royal Navy would be last to re-equip, in 1993.

Despite the earlier ITDU trials, the troop trials revealed a variety of issues with the weapons. Some components proved too flimsy and suffered frequent breakages, while the bipod lock often failed to hold the legs in the closed position. Issue insect repellent melted the plastic furniture, the metal parts rusted quickly in the jungle, sand clogged the mechanism in dusty environments, and the weapons suffered badly from icing in Arctic conditions. The weapons required careful maintenance even in normal conditions, but the cleaning kits issued were flimsy and inadequate. Although left-handed conversion kits were promised during the design phase, none were issued, and the weapons were impossible to use left-handed, as they ejected the hot spent case straight into the firer's face. Most embarrassingly, the exposed magazine release caught on uniforms and webbing, dumping the magazine out of the rifle at inopportune moments.

SA80 variants

Army Cadet Force and Combined Cadet Force detachments had traditionally been valuable feeder organizations for Army recruitment, as well as promoting community engagement and understanding of the Army. The SLR had been too heavy and had too much recoil to be used by young cadets, however, so .22in (5.6×15mm) bolt-action rifles were used for marksmanship training. The lighter weight and lower recoil of the L85 solved this problem, and a simplified version was developed as the L98A1 Cadet Rifle. This was fitted with dual leaf iron sights, while a straight-pull bolt action replaced the gas system, so the weapon was manually re-cocked for each shot. No flash hider was fitted, so the L98A1 could not mount a bayonet. A plastic oil bottle was initially fitted in clips above the barrel, replacing the gas parts, until it was found that the bottle melted as the barrel heated up. Ultimately, the L98A1 was replaced by the L98A2, essentially a semi-automatic-only version of the L85A2 service rifle. It was intended that cadet weapons would provide a reserve of weapons for the Army, as they could quickly be converted to service weapons, but this

proved never to be necessary. The cadet force also had a limited number of standard LSWs, identical to the service version.

Since the bullpup design of the original L85 gave a relatively compact rifle (a length of 785mm versus 840mm for the US M4 Carbine, despite the L85's barrel being 40 per cent longer), no carbine version was initially planned as part of the SA80 family. An extremely short carbine prototype was created by modifying an XL64 weapon used in the NATO trials around 1984, and converting it to 5.56mm. The barrel terminated immediately in front of the pistol grip, with no grip for the forward hand. The prototype was poorly balanced and difficult to use safely, as the left hand could easily slip forward over the end of the barrel, with obvious and painful consequences for the user.

A second prototype appeared in 1989, converted from a standard IW. This had a slightly longer barrel and utilized the rear grip from an LSW relocated beneath the muzzle to act as a pistol grip, so at least the user was unlikely to shoot his own fingers off. A third prototype was produced in 1994 with a rather longer barrel, and fitted with the standard LSW (rather than IW) handguard, in the

The L22 Carbine is usually issued to AFV and helicopter crews, but is also used in other situations where a short weapon is advantageous, as here by a boarding team of HMS *Somerset*. (Cody Images)





ABOVE An L98A1 Cadet Rifle (below) compared to an L85A1 IVW. Note the manual straight-pull bolt, and the absence of a flash hider. This example is not fitted with the usual iron sights mounted on the carrying handle. (Author's Collection)

hope that the ridge at the front would prevent the user's left hand moving forward in front of the muzzle. This relatively low ridge proved inadequate, however, and the weapon was revised once again to mount an LSW rear grip beneath the muzzle as a vertical foregrip, with a prominent stop rib in front of it to prevent the user's fingers sliding forward. This weapon was eventually adopted in 2003–04 as the L22 Carbine, sometimes known as the 'Stubby K'. It was issued where space was at a premium, for example to armour crews or attack helicopter pilots. No L22s were actually produced as carbines; the small number in service (around 2,000 weapons) were converted by Heckler & Koch from existing LSWs, made redundant by the adoption of the Minimi LMG.

As might be expected from its short (442mm) barrel, the carbine has a shorter effective range than the rifle, at around 150–200m. It is notably louder than the rifle when fired, and has markedly harsher recoil and a tendency to muzzle climb, especially on automatic.

RIGHT Three iterations of the SA80 carbine. The top weapon is not fitted with any sights – to be usable, it would need either iron sights like the middle weapon, or a SUSAT optical sight like the bottom one. (Author's Collection)



Perhaps unsurprisingly, the MoD dismissed these as ‘teething troubles’ which would be rectified, reminding everyone that the US M16 rifle had experienced similar problems when first issued, before going on to become a very well-regarded weapon. A total of 32 minor modifications were made over the next eight years to fix some of the reported problems. The most notable were a metal shroud that was glued (early) or welded (later) around the magazine catch to prevent it being released accidentally, replacements for parts that proved insufficiently robust and an improved bipod catch. After the Royal Marines in Norway encountered problems with snow balling behind the trigger, preventing it being pulled, the original flat-backed trigger was replaced by a new design with a V-shaped knife edge on the back, allowing it to cut through accumulated snow. Despite these issues, production of the second tranche of weapons was approved; given the amount of time and money already invested, backing out would have been extremely embarrassing for the MoD. The SA80 was about to undergo a much more severe test, however.

The First Gulf War 1990–91

When the Iraqi dictator Saddam Hussein invaded the small but oil-rich state of Kuwait in 1990, the British government committed 54,000 troops to the US-led coalition to push the Iraqis out again. This deployment – Operation *Granby* – formed about 10 per cent of the total coalition forces, and the largest national element after that of the United States.

Although sand ingress had previously been identified as a problem with the SA80, little had been done to rectify this, and the British troops encountered problems almost as soon as they arrived in Saudi Arabia to begin training in the desert. As Lieutenant Alistair Watkins of the Grenadier Guards remembers:

We soon discovered irredeemable jamming problems with our SA80 rifle. Taking cover in the sand, and any other movement, had to be done very carefully to avoid getting sand anywhere near it, which obviously wasn’t sensible ... We worried all the time about them jamming. Much later, someone buried a captured Iraqi AK-47 in the sand, dug it up then fired and it worked perfectly. Equally, the American M16 rifle was rock solid. (Quoted in McManners 2010: 183)

Lieutenant-Colonel Charles Rogers, commanding The Staffordshire Regiment (The Prince of Wales’s), agreed: ‘If the smallest amount of sand got into our rifle – the SA80 – it jammed. Oiling it, the sand got stuck in the oil, making it worse, and we were to discover further problems with SA80 as the hot weather increased’ (quoted in McManners 2010: 73). Troops used muzzle caps and adhesive tape to seal sand entry-points, kept an empty magazine on the weapon at all times to prevent dirt entering via the magazine well and adopted a routine of cleaning weapons in petrol to remove any oil that might attract sand, then lubricating them liberally immediately before going into action.



British infantry of The Staffordshire Regiment storm a trench system during a live-fire training exercise in Saudi Arabia prior to the 1991 retaking of Kuwait. (© IWM GLF 1425)

When the ground offensive began in January 1991, it was preceded by an intensive aerial bombing campaign which seriously damaged Iraqi ground forces, communication links and infrastructure. Despite some heavy fighting, the coalition forces quickly achieved their objectives, defeating the Iraqi forces encountered and pushing them out of Kuwait before a ceasefire was ordered after only 100 hours of ground combat. The SA80 saw relatively little use due to the short duration of the war itself, and because it largely involved armoured operations in open terrain rather than infantry combat. The troops mostly remained mounted in their vehicles, except for clearing Iraqi positions once they had been

British troops trained in NBC suits for protection from the chemical weapons they feared would be used against them during both Gulf Wars, though thankfully this did not materialize. Respirators significantly degrade marksmanship, particularly in hot conditions when the eyepieces tend to fog. (Cody Images)





A Royal Marine armed with an L85A1 aboard HMS *Brave* during the 1991 Gulf War. (© IWM GLF 524)

overrun. What combat did occur took place at very short ranges (75m or less), and in a number of cases LSW gunners swapped their weapons for IWs issued to the crews of their Warrior IFVs, as the shorter weapon was handier for trench-clearing and able to take a bayonet.

In the aftermath of the fighting, the Army's Land Systems Evaluation Team (LANDSET) reviewed the SA80's performance during the conflict. Their report pulled few punches:

SA80 did not perform reliably in the sandy conditions of combat and training. Stoppages were frequent despite the considerable and diligent efforts to prevent them ... infantrymen did not have CONFIDENCE in their personal weapon. Most expected a stoppage in the first magazine fired. Some platoon commanders considered that casualties would have occurred due to weapon stoppages if the enemy had put up any resistance in the trench and bunker clearing operations. (Quoted in Raw 2003:174)

The MoD was caught wrong-footed when the classified LANDSET report was leaked to the press, and initially dismissed it as 'a fake' before reluctantly admitting that it was genuine. The MoD continued to downplay the report's significance, however, both in the press and to a subsequent Defence Select Committee.

Operation Granby, 1991 (opposite)

The SA80 weapons saw relatively little combat during the First Gulf War, since British infantry only deployed from their Warrior IFVs when Iraqi positions needed to be cleared. Fears over the possible use of chemical weapons meant that most British troops went into action wearing their NBC suits, many of which were in temperate rather than desert DPM material. Fears that wearing the protective suits would lead to heat exhaustion were quickly dispelled, as the invasion took place in some of the coldest weather the region had seen in decades, and many troops actually found themselves glad of the suits for warmth. The soldiers wear Combat Body Armour and Personal Load-Carrying Equipment (PLCE) webbing – note the extra magazine pouches worn by the LSW gunner, who would expect to use up his ammunition faster.

This four-man infantry 'brick' has the standard mix of three L85A1 IWs plus an L86A1 LSW, though LSW gunners in some bricks exchanged their weapons for their Warrior driver's L85A1 since it was handier for trench-clearing and could take a bayonet. The second man hasn't fixed his bayonet so that he can quickly slide an L60A1 Close Assault Weapon (CLAW) rifle grenade over the flash hider if necessary. The black tape holding the forestock of his rifle together was a commonly seen field repair. The last man is assigned to watch the brick's rear – enemies can appear unexpectedly from behind during trench-clearing.



The Balkans, Northern Ireland and Sierra Leone

Although British troops deployed on peacekeeping missions in Bosnia and Kosovo throughout the 1990s, these deployments never escalated into actual combat, so once again the SA80's fitness for purpose was not tested. Troops also continued to provide 'aid to the civil power' in Northern Ireland as part of Operation *Banner* until this finally came to an end in 2007. Weapons were rarely fired in anger on Internal Security tours, but the SA80's compact size was ideal for operations that involved a great deal of urban patrolling and deploying from vehicles. There was considerable criticism, however, that the rifle only being usable from the right shoulder sometimes prevented soldiers making the best use of cover from doorways and street corners.

The SA80 did see combat in Sierra Leone after eleven soldiers from The Royal Irish Regiment and their local liaison officer were taken hostage by a local militia gang – the West Side Boys – in September 2000. Negotiators were able to secure the release of six of the men before their captors' demands became increasingly unrealistic. A rescue – Operation *Barras* – was mounted by the SAS, supported by a reinforced company from 1st Battalion, The Parachute Regiment. They conducted a helicopter assault, defeated the West Side Boys and rescued the British soldiers, along with more than 20 local civilians also held by the gang. Although the SAS troops were not armed with SA80s, the paratroopers were, and two suffered severe malfunctions with their weapons. Fortunately, neither man was injured as a result, though the incident did further harm to the SA80's reputation when the *Daily Mail* newspaper ran the story on 1 August 2000 under the headline 'Paras Face Death as Rifles Jam in Firefight with Rebels'. It emerged that the push-through safety plungers on the prototype weapons had been manufactured from solid nylon rod, before being thoroughly tested to ensure that they were not affected by heat, cold or immersion. These had been replaced on the production weapons by safety plungers manufactured from cheaper injection-moulded plastic, however, apparently without anyone realizing that the plastic swelled when wet, rendering the rifle inoperative.

A British soldier keeps watch with an L86A1 LSW from the top hatch of an FV432 APC during Operation *Lumberjack*, 1993. This was a convoy-protection operation, bringing vitally needed fuel, firewood and medical supplies into the besieged city of Sarajevo. (© IWM BOS 65)



SA80A2 – The Heckler & Koch upgrade

By 2000, it was obvious that something had to be done, both to fix the real problems with the weapon and to build troops' confidence in it. The MoD contracted with Heckler & Koch – then part of the British BAE Systems' Royal Ordnance division – to have the existing stock of SA80s shipped to Germany and rebuilt in an attempt to fix the problems. Heckler & Koch used high-speed cameras to record the firing cycle of the weapon and then developed a package of modifications in six key areas:

- (1) Rounds often failed to feed from both British- and US-designed magazines, as the magazine platform could cant to one side and present cartridges at erratic angles. A more robust magazine was developed with a redesigned follower which caused fewer misfeeds.
- (2) Friction among the moving parts – particularly the bolt and carrier – meant that there was sometimes not enough power to cycle the action properly, especially with heavily fouled weapons. The contact areas were given a highly polished finish to reduce friction.
- (3) The springs within the working parts were not strong enough and sometimes failed to return parts to their original positions. The springs were replaced with stronger equivalents.
- (4) Extraction and ejection were improved by fitting a more robust extractor claw, a modified and enlarged ejection opening and a new dished 'paddle'-shaped cocking handle that deflected spent cartridge cases away from both the weapon and the user's face.
- (5) A new barrel was developed for the LSW, using better materials and chromed internally for longer life and greater heat resistance.
- (6) Finally, a number of components prone to breakage, including parts of the trigger mechanism, were modified to make them more robust.

Although these changes improved the weapon significantly, the upgrade had to work within the constraints of the existing design, which meant some problems could not be fixed. Most notably, the reciprocating cocking handle inevitably meant that the long, open slot in the side of the body it travelled in remained a potential entry point for dirt.

The upgraded weapons began troop trials in 2001, and scored much better in tests of reliability across all climates; indeed, the weapons now exceeded the original MRBF targets by a considerable margin without the figures needing to be manipulated. Stoppages also decreased markedly, though reliability scores in hot, dusty environments were still notably poorer than for other environments. The upgraded weapons became the new standard issue in 2002 as the L85A2 IW and L86A2 LSW, respectively. Initially, the Army planned to have all 300,000 weapons still in service rebuilt to the new standard, but this soon dropped to 200,000 weapons, apparently on the grounds of cost. About 20,000 of the weapons not upgraded were stripped for use as spares, while the remaining 80,000 were offered for sale to a number of foreign governments. Little overseas interest seems to have been shown, however, and it is likely that these weapons will either be upgraded at some future point or (more probably) also used for spares.

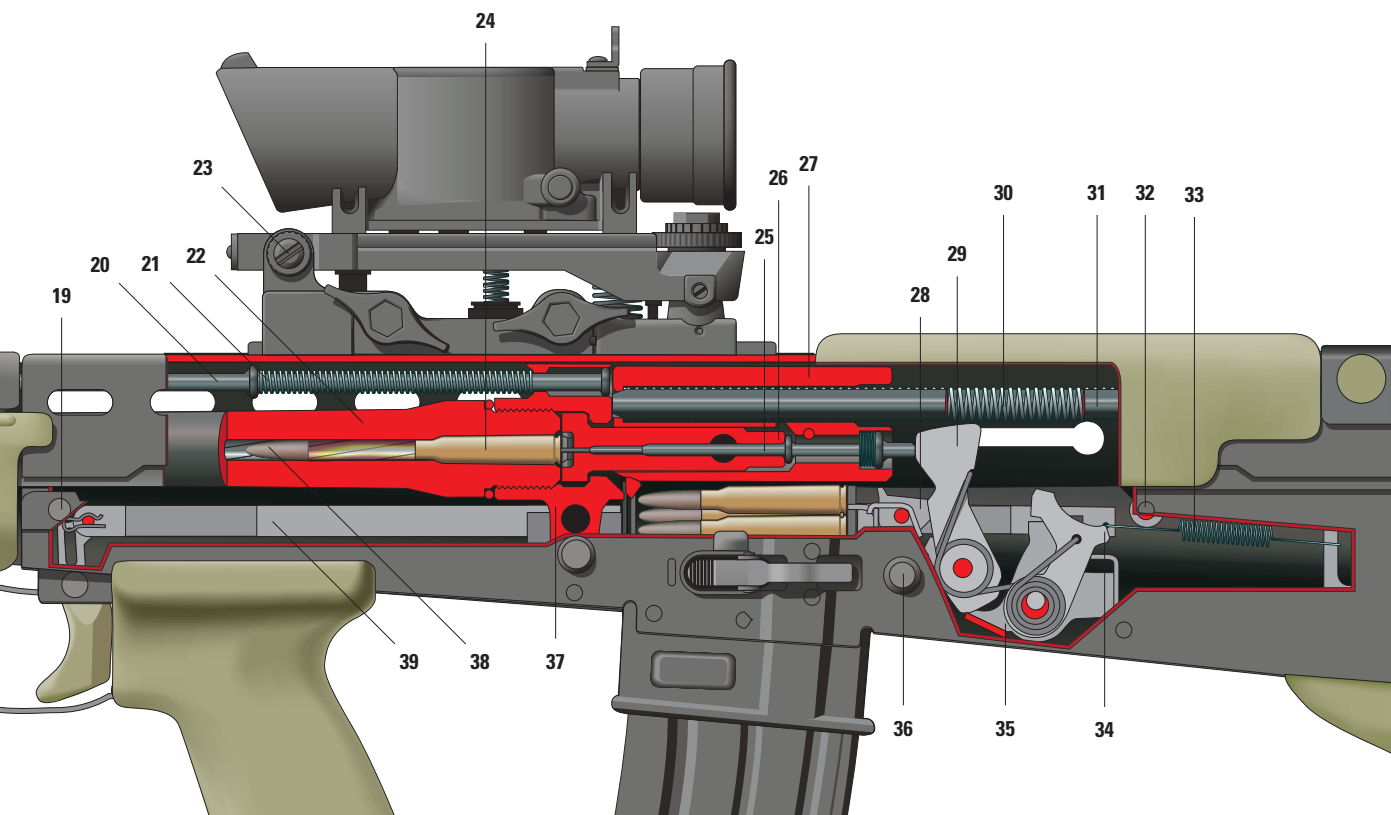
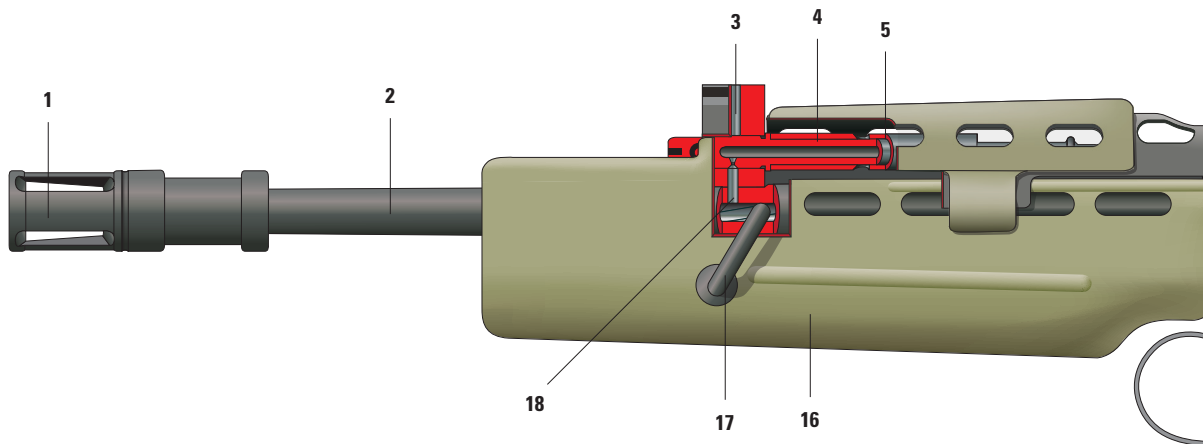
Even with only 200,000 weapons upgraded the cost still came to around £92 million, or about £460 each. The MoD justified this by arguing that it was still cheaper than the £500m that would be necessary to procure a new weapon and bring it in to service, after including procurement costs, developing new manuals and training packages and so forth on top of the cost of the weapons themselves.

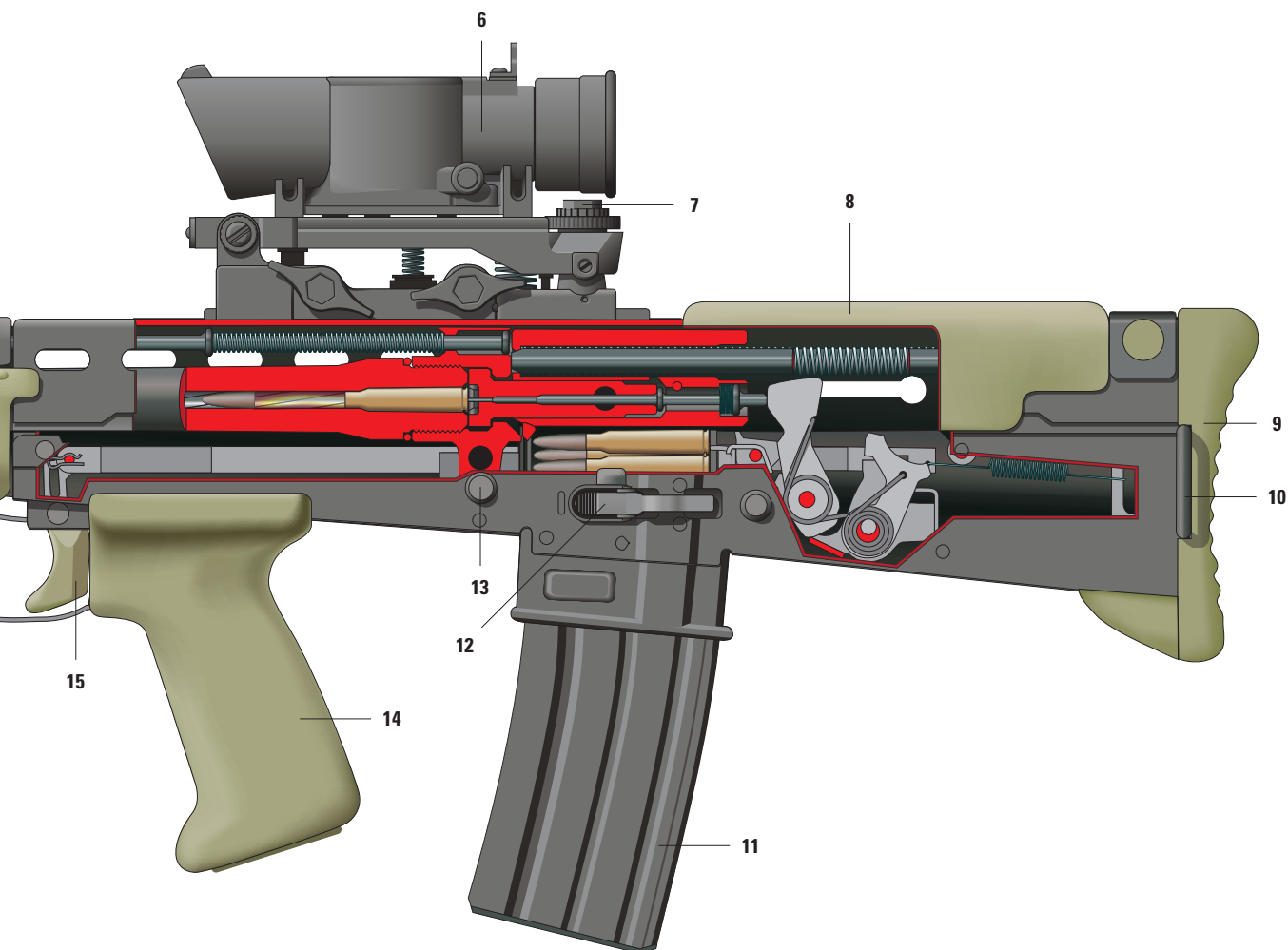


The lower interface rail of the operational handguard could be blanked off with a simple cover, though a vertical 'grip pod' was normally fitted. (Cody Images)

THE SA80 EXPOSED

5.56x45mm L85A2





- | | | |
|---|---------------------------------|------------------------|
| 1. Flash eliminator | 14. Pistol grip | 27. Bolt carrier |
| 2. Barrel | 15. Trigger | 28. Safety sear |
| 3. Gas block and front iron sight mount | 16. Handguard | 29. Hammer |
| 4. Gas plug | 17. Sling mount | 30. Recoil spring |
| 5. Gas cylinder | 18. Gas vent | 31. Recoil guide rods |
| 6. SUSAT sight unit | 19. Safety catch | 32. Bolt release catch |
| 7. Vertical adjusting nut | 20. Gas piston | 33. Trigger bar spring |
| 8. Cheek piece | 21. Gas piston spring | 34. Interceptor sear |
| 9. Butt pad | 22. Barrel | 35. Main sear |
| 10. Sling mount | 23. Horizontal adjusting screws | 36. Retaining pin |
| 11. Magazine | 24. Cartridge in chamber | 37. Barrel extension |
| 12. Magazine release catch | 25. Firing pin | 38. Bullet |
| 13. Retaining pin | 26. Bolt | 39. Trigger bar |

First deployments to Afghanistan

The UK had little involvement in the initial overthrow of the Taliban regime in Afghanistan by the United States and its Northern Alliance allies in 2001. It did provide a limited number of troops, though, giving the new SA80A2 its first real combat test. The troops deploying were issued with hastily purchased FN Minimi 5.56mm Light Machine Guns, one per four-man infantry 'brick'; the same ratio as with the LSW. The Minimis were officially to 'supplement' the LSW, which was still issued, rather than 'replacing' it. However, it was a clear de facto acceptance that the troops needed a better sustained-fire capability than the LSW could provide. In respect of the SA80A2 itself, 2nd Battalion, The Parachute Regiment – the first unit actually to fire the new weapon under combat conditions – gave a positive assessment. Their successors from the Royal Marines' 45 Commando were far more critical, however, reporting significant issues with misfires and jamming.

The MoD launched an immediate investigation, led by a Royal Marines colonel. When initially tested, only two out of 12 sample weapons operated properly when used to fire a trial shoot of 150 rounds. The investigation found, however, that the Royal Marines were struggling to clean their weapons properly because of inadequate or worn-out cleaning



kits, had a number of worn or damaged magazines and were not following the oiling regime in the weapon manual. A follow-up test after the weapons had been cleaned and oiled in the textbook manner found only one weapon failing out of the 24 selected. As a follow-on test, the group of 24 Royal Marines who had received coaching in the 'textbook' drills plus a 'control group' of 12 Royal Marines who had not received the coaching were run through a second trial, including multiple disembarkations from helicopters. The weapons of the men who had followed the revised cleaning regime turned in an 87 per cent reliability average, while the weapons of the control group averaged only 17 per cent. The conclusion was that the new weapon was indeed reliable in dusty conditions if (and only if) the troops were very rigorous about cleaning and oiling it to a much higher standard than other weapons might require in the same conditions. As one Royal Marines officer put it: 'The weapon fires properly if you clean it properly – the problem is that it is very difficult to clean it when you are conducting military operations' (quoted in Raw 2003: 296).

The Second Gulf War and its aftermath (2003–07)

Although Saddam Hussein had been defeated in the First Gulf War, the internal uprising the Western allies hoped would topple him afterwards came to nothing, and he remained in power. Some US leaders regarded him as 'unfinished business', and believed his regime was attempting to acquire nuclear and chemical 'Weapons of Mass Destruction', leading to a second invasion of Iraq by a US-led coalition in 2003. The British contribution to the campaign, -- Operation *Telic* -- saw 46,000 British troops involved, again forming the largest contingent after that of the United States.

The ground campaign was preceded by a heavy air offensive, which significantly degraded Iraqi forces, and coalition troops gained control of the country in three weeks of fighting. The coalition had expended little effort on planning what would happen after the invasion, however, apparently believing that a democratic civil society would arise more or less spontaneously after Iraq was 'liberated'. This proved extremely optimistic and after a short 'honeymoon period', various political and religious factions began a struggle for power, attacking both each other and coalition forces.

British forces were largely based in Basra and Al 'Amārah, in the south of the country. Initially, they patrolled wearing berets and undertook 'Hearts & Minds' infrastructure projects to improve life for the local population. By 2004 the situation had deteriorated, however, partly due to the rise of the 'Mahdi Army', led by the Islamist cleric Muqtada al-Sadr, which attacked British forces at every opportunity. This post-invasion phase, often termed 'the Iraqi insurgency', was characterized by urban patrolling on foot and in vehicles. Infantry weapons such as the SA80 system saw heavy use, although ambushes using Improvised Explosive Devices (IEDs) and roadside bombs became more common in the later phases. British forces handed back control of Basra to the Iraqi

OPPOSITE Afghanistan, June 2009: Welsh Guardsmen return fire with an L110 Minimi LMG and an L85 IW with the early laser module fitted. The FN Minimi was designed as a 'pure' machine gun; it lacks a single-shot capability and fires from an open bolt to allow cooling between bursts. A quick-change barrel allows prolonged sustained fire; when the barrel overheats, the user can change it in 6–7 seconds and keep firing using the spare barrel while the original cools. Although the Minimi normally feeds from 100- or 200-round belts held in a carrier clipped under the weapon to keep out dirt and prevent the belt tangling while on the move, it can also feed from a standard M16 magazine, inserted into a port normally covered by the belt feedway. The British Army adopted both the standard model with a 465mm barrel (as the L108A1) and the shortened 'para' model with a 349mm barrel (as the L110A2). Both versions are generally fitted with the 4x SUSAT optical sight, and have replaced the L86 LSW in most applications due to superior sustained-fire performance. (Cody Images)





Operation *Telic*, 2006 (previous pages)

After the Iraqi Army was swiftly defeated in 2003, British troops took over the city of Basra and the surrounding area. They initially patrolled in soft hats in an effort to win 'hearts and minds' but rapidly found themselves dealing with a simmering insurgency. Since vehicles such as the Warrior IFV were both too big and too 'aggressive looking', the lightly armoured 'Snatch' Land Rover – developed for service in Northern Ireland – was often used for urban patrolling, but it was found to offer insufficient protection, particularly against roadside bombs.

These troops wear early versions of Osprey body armour, with rigid plates that offered increased protection over earlier armour but at the cost of increased weight. Ammunition pouches and other equipment such as Camelbak water bladders could be attached directly to the armour, removing the need for separate webbing. Two soldiers of this four-man infantry brick are armed with L85A2 IWs, while a third has an L108A1 Minimi LMG, newly issued for Operation *Telic* to provide a better automatic-fire capability. The fourth and final soldier carries an L86A2 LSW, which was retained to provide additional supporting fire and to allow accurate shooting at longer ranges.

Fire could come from any direction in an urban setting, including the upper windows of apartment blocks, so the infantry have deployed to cover all directions while the 'top cover' man on the Snatch Land Rover maintains a constant visual search of his surroundings. The vertical wire-cutter bar at the front of the vehicle was very necessary, as cables were sometimes strung across streets to decapitate anyone standing in the top hatch.

authorities in 2007, though some troops remained in supporting roles until 2009. A total of 179 British personnel were killed in Iraq between 2003 and 2009.

Many soldiers had concerns at the start of the campaign about how the L85A2 IW might perform, despite the Heckler & Koch upgrade. Colonel Tim Collins of 1st Battalion, The Royal Irish Regiment – better known for the eve-of-battle speech he gave to his men – commented in the run-up to the war: 'I was still concerned about the number of stoppages we were getting with our weapons and the only solution seemed to be lots more oil on the working parts, which is exactly the opposite of what you would expect in sandy conditions' (Collins 2005: 125). In fact, the L85A2 performed surprisingly well, albeit at the cost of requiring very rigorous cleaning and maintenance, and there were few major problems with reliability. The LSW did less well, however, since its problems of magazine (rather than belt) feed and lack of a quick-change barrel still limited the weight of fire it could put down and hampered its sustained-fire performance. The MoD had purchased another 700 Minimi LMGs in the run up to the war, and these had effectively taken over the squad automatic weapon role which the LSW had originally been designed to fulfil. Even so, the MoD put a brave face on things, stressing once more that the Minimis had been purchased to 'supplement' rather than 'replace' the LSW, which remained on issue to each four-man infantry brick as a second automatic weapon or 'heavy rifle', its longer barrel and bipod enabling accurate shooting at longer range.



A British soldier in Iraq during the Second Gulf War. The forestock and magazine of his L85A2 IW appear to have been camouflaged with sand-colour paint. (Tom Laemlein / Armor Plate Press)

The return to Afghanistan

In 2006, the British Government agreed to increase British troop numbers in Afghanistan – Operation *Herrick* – despite Army concerns about overstretch as a result of beginning operations in Afghanistan while significant numbers of troops were still committed in Iraq. The British were to take over security in Helmand province, which was seen as a relatively ‘quiet’ area. The Defence Secretary, John Reid, even expressed a hope that the British force would be able to complete its mission ‘without firing one shot’. In fact, it quickly became obvious that Helmand had been peaceful to date only because the Taliban’s dominance of the area had not previously been challenged, and the British forces (based around 3rd Battalion, The Parachute Regiment’s battle group) found themselves in heavy combat almost immediately.

Strategically, the British were also hampered by a politically imposed limit on troop numbers, and by frequent requests from the Afghan Government that they supply small units to defend local ‘district centres’ threatened by the Taliban. It was then difficult to relinquish defence of

A British patrol in Afghanistan in 2009 displays a typical range of small arms: an L85 with operational handguard, an L85 with grenade launcher and a Minimi LMG. (Cody Images)



A British soldier in Afghanistan, 2011. Note the muzzle cover on his rifle, and the sling short-looped around the butt to avoid catching on obstacles. All infantrymen in theatre were issued pistols as back-up weapons by this point. (Tom Laemlein / Armor Plate Press)



these locations without it being presented as a Taliban victory, leaving the British troops tied down in static defensive positions which were often hard to reinforce or even resupply, and which were repeatedly attacked or bombarded by the Taliban. Much of Helmand was arid semi-desert, but the irrigated ‘green zone’ along the Helmand River was densely vegetated, especially in summer, and contacts could take place at very short range. While the British had routinely been able to deploy Warrior IFVs and even Challenger main battle tanks in Iraq, the rough terrain in Helmand was less suited to heavy armoured vehicles, and the fighting was dominated by patrolling on foot and in light vehicles, and by the defence of ‘platoon

house’ outposts established in various district centres.

This placed a heavy emphasis on man-portable small arms such as the L85, and saw the GPMG come back into regular usage in infantry sections to enhance their firepower. Meanwhile, the L86 LSW largely fell from use, even in the limited ‘long range rifle’ role. As in Iraq, however, the main threat to British troops was IEDs, though the Taliban were significantly more willing to engage in direct combat than the Iraqi insurgents had been. No significant problems were reported with the SA80 system in the various accounts of the war, though it remained sensitive to grit and dust unless carefully looked after. A total of 453 British personnel were killed in Afghanistan before the last British forces left in October 2014.



An L85A2 fitted with interface rails, grip pod and ACOG sight. The loose cable is the press-switch for the laser module mounted alongside the weapon; it would normally be taped to the grip pod. (Author's Collection)

The 2009 'Operational Upgrade'

From 2009, SA80A2 weapons issued to units deployed operationally to Afghanistan received a package of upgrades under an Urgent Operational Requirement that significantly changed the appearance of the weapon, along with the issue of lighter Magpul polymer magazines. The most obvious aspect of the upgrade was the replacement of the original green plastic foregrip with NATO-standard interface rails on all four sides of the barrel, similar to those fitted to the US M4 Carbine. The rails allow quick and easy mounting of accessories such as vertical foregrips, scopes, tactical lights and so forth, without needing to modify the weapon. When not in use, the interface rails were protected by slotted plastic covers, produced in both green and desert tan plastic.

Most IWs had a 'grip pod' mounted on the lower rail. This acted as a vertical front foregrip, allowing the user to pull the weapon into his shoulder more effectively when wearing bulky body armour. The shaft of the grip pod contained a small bipod which extended out at the flick of a switch. The original idea was to allow the weapon to stand upright on the bipod rather than being laid on its side on the ground when not in use, thus helping to keep dust out of the action. It could also be used to steady the weapon when firing from the prone position or over cover, improving accuracy. Other elements of the upgrade included the ACOG sight, to replace the older SUSAT optical sight, and a new Surefire flash hider.

The upgraded weapons are sometimes referred to as L85A3 – or even L85A4, when fitted with the ACOG sight and a laser module –

but these are not official designations. Heckler & Koch did produce a small number of replacement lower bodies which were marked as 'HK A3' but this is a manufacturing reference; the components are identical to the refurbished components marked 'HK A2'.



A British soldier armed with an L85A2 with operational handguard and the early laser module in Afghanistan, 2011. The transparent window in the polymer magazine lets users check rounds remaining at a glance. (Tom Laemlein / Armor Plate Press)

USING THE SA80 WEAPONS

Firing the SA80

All weapons in the SA80 family are loaded and fired in the same way. The requirement for a left-handed version was dropped, despite 11 per cent of troops being left handed. The Army maintains, however, that most left-handed soldiers can be taught to shoot from their right shoulders equally as well.

Starting with an unloaded weapon with the safety catch applied, the user inserts a loaded magazine into the magazine well in the butt, and pushes it home until it locks into place. Pulling back the cocking handle on the right side of the body strips the first round off the top of the magazine and loads it into the chamber. This requires reaching across the top of the weapon - slightly awkward compared to the SLR, where the cocking handle is on the left, or the M16, where it is behind the carrying handle.

Infantry versions of the SA80 were fitted with a 4x SUSAT optical sight as standard. The SUSAT was later replaced by ACOG and ELCAN designs, while weapons issued to support troops had less expensive 'iron sights' built into a carrying handle instead.

Gravity and air resistance mean that bullets actually travel in a parabola, rather than a straight line, so the sights had to be adjusted for

targets over 300m. Soldiers were taught how to estimate range, and entered the correct range (in 100m increments from 300m to 800m) by adjusting a range drum on the sight body to compensate for this curved path. With the sights adjusted, the firer aimed by placing the tip of the upright post of the optical sight on the target.

The safety catch was a push-through button ahead of the trigger guard; operated by the trigger finger, it was pushed to the left to fire and to the right to make the weapon safe again. Some users expressed a preference for an M16-style tumbler safety, operated by the thumb while the finger remained on the trigger.

British soldiers were taught to fire aimed semi-automatic shots rather than bursts, but the SA80 is also capable of full automatic fire. The selector switch is a separate two-position tumbler on the left side of the weapon body - a convenient location on an LSW being used from its bipod, but less convenient for a rifleman, perhaps reflecting the Army's

A British soldier takes cover during a patrol in Belfast, 1995. The location of the ejection port prevented the weapon being fired from the left shoulder, which made firing round the left side of cover problematic. (© IWM HU 98402)



preference for semi-automatic fire. The two settings were marked 'R' (repetition) for single-shot and 'A' (automatic). The switch was pushed up for semi-automatic, and down for automatic fire. Again, some users felt that an M16-style tumbler combining both safety and selector might have been a better option.

Trigger pull is reasonably smooth. The 5.56mm cartridge produces relatively low recoil which is easily controlled by a good firing stance, especially when compared to the powerful recoil of the old 7.62mm SLR. The SA80's in-line design also means that the recoil is mostly backwards, limiting muzzle climb. Firing from the hip is not recommended; aside from the poor accuracy of shooting without using the sights, the right forearm coming from above the weapon rather than below means there is a risk of it being struck by the reciprocating cocking handle.

Firing noise exceeds 160 decibels – enough to cause some hearing damage for troops firing the weapon regularly. While this is rarely the most pressing concern in battle, hearing protection is standard in training, and electronic ear protectors that damp down damaging peak sounds to safe levels while allowing quieter sounds such as normal speech are now starting to be used even on operations.

The weapon's bullpup design puts the point of balance above the pistol grip, allowing it to be held and even aimed one-handed, though it cannot be fired like that with any real accuracy. Empty cartridge cases are ejected from the right side of the weapon; aside from making things difficult for left-handed users, this also prevents right handed users shooting from their 'off' shoulder. This had been routinely taught with the SLR, so that soldiers firing around the left side of cover exposed as little of themselves as possible.

Once the last round is fired, the top edge of the magazine follower catches the bolt carrier and prevents it going forward, warning the user that he needs to reload. Once a new magazine has been inserted, the hold-open catch is released, allowing the bolt to go forward and pick up the first round.



A member of 29 Commando Regiment, Royal Artillery uses his ski poles to stabilize his L85 during Arctic training in Norway. (MOD © Crown copyright 2014)

Training

Being able to use his weapon is a soldier's most important skill, and the British Army puts considerable effort into making training as realistic as possible. As Colonel Tim Collins put it:

If we were to avoid casualties in combat I had to ensure where possible that each man regarded his weapon system as an extension of his body and could react at an instant when a threat arose. This involved not only training the men to shoot straight, but to do so at night, under pressure and when exhausted and even frightened. (Collins 2005: 100)

Troops start out learning to shoot against static targets on the range, but rapidly add contact and skirmish drills, firing at targets on the move. Royal Marine Jake Olafsen remembers

learning about how to shoot properly, trajectories, theories of flight, and all sorts of good stuff ... We stripped and reassembled our rifles over and over again, and we were getting faster and faster each time. As we would be putting our rifles together the instructor would wander around asking questions about the effective range of the weapon, or what the name of some small part was. If you didn't answer fast enough or simply didn't know, there was always some sort of punishment waiting for you. (Olafsen 2011: 22–23)

A Welsh Guardsman wearing a Tactical Engagement Simulation sensor harness during tactical training in 2008. His L85 has a blank-firing attachment and laser emitter attached, and a yellow-striped 'blank only' training magazine. (Cody Images)



Every recruit had to pass the Annual Personal Weapon Test (APWT) in order to complete their basic training. As the name suggests, the test had to be retaken each year, usually after completing a run in order to simulate the adrenalin and exertion of combat. The Military Annual Training Test (MATT) replaced the APWT from 2006, but the content did not differ greatly. The APWT or MATT was a minimum standard for all soldiers, and training continued well beyond that point, especially for infantrymen. The training cycle that preceded any operational deployment invariably featured marksmanship refreshers, often customized to reflect the mission. For instance, troops deploying to Northern Ireland during 'the Troubles' received a refresher in urban patrolling at 'Tin City' at Sennelager in Germany, which featured mannequins that could interact with the soldiers verbally as well as pop-up targets, or at the Lydd and Hyde Close Quarter Battle (Urban) ranges in Britain.

A simulated 'West European village' was built at Copehill Down in Wiltshire in

1990 for urban warfare training. It was modified (somewhat unconvincingly) into an Afghan village by sticking a crescent on top of the church, before purpose-built training environments became available. In 2009, Afghan villages were created at the Stanford Training Area (STANTA) in Norfolk and the British Army Training Unit Suffield (BATUS) training area at Suffield in Alberta, Canada. Both were complete with Afghan-style compounds and even marketplaces. They were staffed by Afghan civilians the troops could interact with during a variety of scenarios, while former Gurkhas played the role of insurgents. Mock-up compounds were also built at Camp Bastion in Afghanistan for troops to practise clearing drills.

Experience in Afghanistan led to changes in marksmanship training, with greater emphasis being placed on firing from standing and kneeling positions to reflect operational reality. More time was spent on close-quarter drills and soldiers were trained to transition to their back-up weapon rather than trying to clear a serious stoppage, after pistols became standard issue for all infantry in theatre. A sub-calibre training kit produced by Heckler & Koch allowed the use of low-powered .22in rimfire ammunition, for training on indoor ranges. Tactical training was enhanced by use of blanks and by the Small Arms Weapon Engagement System (SAWES) and its replacement, the Tactical Engagement Simulation (TES). Both of these involved the use of low-powered lasers mounted on weapons, which scored 'hits' on sensors on opponents' helmets and harnesses. Any hit deactivated the 'victim's' weapons and set off alarms on their harness, which only stopped when he lay on his back.

Trainers saw immediate improvements when these systems were introduced in the mid-1980s – aside from removing argument about whether a man was out of action or not, soldiers behaved more realistically, used cover better, and often found they had to deal with the 'fog of war' when section and platoon commanders became casualties. The pay-off from this training proved critical in real combat. Paratrooper Sergeant Major Jimmy Fitzwilliam described combat in Sierra Leone:

Once the rounds started going down, your training does kick in. You remember what you have practised and trained for all those years and you just do it. It's like driving a car; you don't think about what your foot's doing on the pedal or what your hands are doing on the gear stick, and how you coordinate the two actions, you just do it automatically. (Quoted in Danziger 2010: 156)



Manroy Engineering produced inert 'dummy' weapons issued to recruits during activities such as assault courses, to save damaging actual weapons while still simulating a realistic load. (Author's Collection)

Magazines

The original 4.85mm prototypes used straight 20-round (IW) and 30-round (LSW) steel magazines, but with the change to the NATO-standard 5.56mm calibre, the weapon was modified to accept the STANAG 30-round magazines used by the M16. These had a rather odd curved shape, as a compromise between the curve optimized for cartridge feed and the straight top section required to fit into the M16's deep magazine well. Adopting them also meant changing the way the magazine locked in place. Plastic magazines were trialled for the XL70 series, but proved insufficiently rigid without strengthening ridges, which then made them too bulky to fit into the standard magazine well.

In fact, the lightweight aluminium US magazines initially issued proved to be problematic, as they did not always feed reliably in the British weapons. They were replaced by steel magazines produced at Radway Green in Cheshire, but these were in turn replaced as part of the A2 upgrade by more durable (and expensive) steel Heckler & Koch magazines. These had a deeper follower platform, which did not cant while feeding and thus presented rounds to the bolt more consistently, thus improving reliability. A specialized version of the Heckler & Koch magazine was produced specifically for blank ammunition used during exercises. This was marked with high-visibility yellow striping, and fitted with a plate which shortened the internal space. This

reduced space would hold the short crimped-case blank rounds, but prevented full-length bullet rounds being loaded accidentally.

From 2011, Magpul moulded-polymer magazines were issued to infantry units on operational deployments. The first version of these magazines had solid sides, but later versions had a clear window in one side, allowing the user to check how many rounds remained in the magazine without having to remove it to do so. The magazine's follower spring was coloured yellow, and when that came into view through the window, the firer knew he was down to his last five rounds. Each of the polymer magazines came with a detachable dust cover to keep grit and dust out. At 130g each, the Magpul magazines were just over half the weight of the previous 240g steel magazines, offering a welcome saving of nearly 1kg on a load of ten magazines.

Magazines were sometimes stored in pouches with the open end downwards, so that water drained out if they became wet, and troops doing this often attached black tape pull-tabs to the bottom of magazines to allow them to be removed from pouches more easily. Some of the polymer magazines were fitted with commercially made rubber pull-loops, for the same reason.

Magazines were regularly disassembled and cleaned to ensure reliable feeding, especially in dusty environments, as Captain David Blakeley of The Parachute Regiment describes: 'Each man had six thirty round mags for his assault rifle in his webbing,

Ammunition load

One of the advantages the Army anticipated from changing to a 5.56mm weapon was lighter ammunition loads, since 5.56×45mm ammunition is less than half the weight per round of 7.62×51mm ammunition. This was partially offset, however, by concerns that the SA80's automatic capability would mean troops expended ammunition at a faster rate, and would thus need to carry more of it. Riflemen were initially issued four 30-round magazines (i.e. 120 rounds); LSW gunners were issued eight 30-round magazines (240 rounds) since they were expected to use their weapons for automatic fire to a much greater extent. The standard issue for riflemen was quickly increased to six 30-round magazines, but this still proved to be inadequate in practice. Men generally carried as much ammunition as they could, bearing in mind the significant weight of armour, grenades, radios and water (at least three litres in the Afghan heat, and preferably more) they also had to carry. Dan Mills describes what his men carried in Iraq:

I liked the boys to carry as much ammo as they could. The standard drill was six magazines of thirty rounds in each. But we always took out ten per bloke, plus a bandolier that held another 150 rounds, packed into a piece of green material and slung around the shoulder. That made a total of 450 rounds of ammunition per man. (Mills 2007: 38)

the first facing forwards and the right way up, so it would slot directly into the weapon. Every few days we'd de-bomb our mags, getting rid of any dust and grit, then check and oil the spring and reload it. Some guys only loaded twenty-nine rounds per mag, so as not to overstress the spring' (Blakeley 2012: 130). Eventually, even the manual recommended loading only 28 rounds per magazine in dusty conditions, thus providing space at the bottom

for any dust that entered the magazine to gather.

The 5.56mm ammunition was usually issued in disposable green cotton bandoliers of 150 rounds, allowing troops to carry extra ammunition easily. The cartridges themselves were packaged in disposable stripper clips so that magazines could be reloaded quickly in action, ten rounds at a time. The Army trialled the 100-round Beta C-Mag double-drum magazine as an option to fix the limited ammunition capacity for the LSW, but this did not always feed reliably with British ammunition, and so was not adopted.



SA80 magazines (L to R): an original aluminium M16 magazine; a British-made Radway Green steel magazine; an improved Heckler & Koch steel magazine; the special Heckler & Koch blank-only magazine; and a Magpul polymer magazine fitted with a pull-loop for easy removal from an ammunition pouch. Below the magazines are the early blank-firing adaptor (left) and the later version (right). (Author's Collection)

Captain Leo Docherty of the Scots Guards carried a similar load in Afghanistan: 'My pouches contain five magazines of 30 rounds each (there's one fitted to my rifle), two bandoliers of 5.56 ammunition (300 rounds), two smoke grenades, a red phosphorous grenade and a high explosive grenade' (Docherty 2007: 125–26). Some units loaded their magazines in a specific sequence, like paratrooper Jake Scott:

My team loaded their rounds the same way as me: three normal ball 5.56mm at the bottom followed by three tracer 5.56mm; this way you had an indicator that you were nearly out of rounds when your tracer rounds start flying downrange, because you never count your rounds when it goes for real ... The rest was made up of normal 5.56mm ball until the top. Again, I put three tracer 5.56mm together with two ball 5.56mm sitting on top to finish my magazine. In the Army there is a sequence on reaction to effective enemy fire: the first two being the double tap in the direction of the enemy, which would use the two normal 5.56mm ball rounds at the top of your mag ... [followed by] ... unloading tracer rounds into the target area and therefore clearly identifying the enemy position to your muckers [mates] around you. (Scott 2008: 31–32)

Caring for the SA80

‘In a place as dirty and dusty as Iraq, you would clean your weapon every single day,’ recalled Sergeant Dan Mills.

That meant stripping it down, wiping every surface with a cloth, cleaning out any dirt, carbon or gunpowder residue, oiling the moving parts, wiping it down again, reassembling it, and finally performing a function check by cocking it and pulling the trigger. It takes between fifteen and twenty minutes. You do it so often that the whole process doesn’t require any thought at all. It became a ritual. And you’re happy to do it, because you know that lump of steel can save your life. (Mills 2007: 42)

Any weapon needs daily care to remain functional, but the SA80 needs more than most. It is a relatively complex weapon to strip, as Steve McLaughlin of The Royal Green Jackets discovered in basic training:

We were introduced to the SA80 assault rifle and began lessons on how to operate it, strip it down and clean it. I was shocked at how complex the thing was – it broke down into more parts than a kid’s jigsaw. I had presumed the rifle split into two like a shotgun and would just have a few simple mechanisms to clean. Boy was I wrong on that one. The rifle was more like a small engine than a gun – springs, bolts and screws fell out of it like confetti. It was a seriously complex weapon. (McLaughlin 2007: 51–52)

Two soldiers from 1st Armoured Division strip and clean their L85A1 IWs during the First Gulf War. (NEWS SYNDICATION)



When McLaughlin later encountered the M16, he found it simple by comparison.

Soldiers used a variety of methods to try to keep sand out of the SA80's sensitive action, including adhesive tape to seal external openings and keeping an empty magazine permanently attached to the weapon to prevent dirt entering via the magazine well. The long open slot in the side of the body for the reciprocating cocking handle made this difficult, however, as the weapon would not operate with it taped over. The issued plastic muzzle covers were a simple friction fit which unfortunately meant they froze in place in the Arctic but expanded in the heat of the desert, making them difficult or impossible to remove in either case. They also lacked a retaining cord, which meant they were often lost if removed in haste or while wearing gloves.

Weapon maintenance was not helped by the poor quality of the initial-issue cleaning kits; the brushes were inadequate, the pull-through was difficult to get down a fouled barrel and the oil bottles split or leaked, leading to many soldiers replacing them with non-issue items until an improved cleaning kit was finally issued with the A2 version.

An SA80 cleaning kit. Clockwise from bottom left: pull-through, three-part cleaning rod, brush, flannelette, two combination tools (closed and open), magazine-loading tool, cleaning kit holdall and oil bottle. (Courtesy James Langham)







Rules of Engagement

In recent conflicts – whether in Northern Ireland, Iraq or Afghanistan – when and how British troops could use their weapons was governed by strict ‘Rules of Engagement’ (ROE) intended to prevent civilian casualties. These rules were printed on a card known as ‘Card Alpha’ or the ‘yellow card’ and issued to every soldier. There were actually several different sets of ROE such as ‘Rule 429’ and ‘Rule 421’, some more restrictive than others. Almost all except the ‘war-fighting’ Rule 429 effectively meant that troops could only fire against clear targets engaged in hostile acts, although this need not mean actually firing weapons.

For instance, insurgent forward observers in Iraq initially stood – conspicuously unarmed – in plain sight, observing the fall of mortar fire at British troops through binoculars and correcting the aim via mobile phones. The Army received legal advice that this did constitute ‘engaging in direct attack’, however, and the next insurgents to do so were promptly eliminated. In many circumstances – even in war zones – troops were interviewed by Royal Military Police officers after a shooting incident, and were aware that they could face legal or disciplinary consequences for improper use of force. In Northern Ireland, troops had to account for every live round issued to them and not returned. Doug Beattie, Regimental Sergeant Major of 1st Battalion, The Royal Irish Regiment, explains how the ROE worked from the point of view of a man in combat:

An SA80 rifle stripped to its main components. Note the twin guide-rails which carry the working parts, instead of the light metal body pressings. (Cody Images)

OPPOSITE An Army Air Corps ground crewman using a home-made weapon cover and a condom to keep sand away from the working parts of his SA80 in Kuwait during Operation *TELIC*, 2003. (© IWM OP-TELIC 03-010-09-026)

I took one shot – and another – at a quartet of enemy fighters scurrying between a pair of compounds just the other side of the canal. Then I switched the weapon to automatic, loosing off short bursts at more fleeting figures as they darted back and forth ...

In Afghanistan British troops work under the rules of engagement as defined on the so-called Card A. As I tried my damndest to kill my enemy, the wording on that card came into my mind.

Firearms must only be used as a last resort in protection of human life. You are only to open fire against a person if he/she is committing or about to commit an act likely to endanger human life and there is no other way of stopping it.

Well, I was covered there, then. Human life was being endangered. Mine. I fired another burst.

A challenge MUST be given before opening fire unless to do so would increase the risk of death or grave injury to you or any other person other than the attacker(s).

Yep, covered there pretty well too.

I ducked down to release the now-empty magazine and shove a fresh one home. Raising my head again, I caught sight of two more Talibs, in the open, a mere twenty metres away. Should I give them fair warning? ‘Army, stop or I shoot’? Sod that.

I brought my rifle to bear and pulled the trigger. One of the men went down as the rounds hit him, while the other scampered away.

If you have to open fire only fire aimed shots, fire no more rounds than are necessary, take all reasonable precautions not to injure anyone other than your target.

Targets? These weren’t ****ing metal plates with human effigies painted on them, sitting at the bottom of the range. They were fighters whose goal was to wipe us out. I wasn’t counting rounds. I was trying to stay alive.

This guidance does not affect your inherent right to self defence. However in all situations you are to use no more force than absolutely necessary. (Beattie 2009: 143–44)

In some cases, this meant that opponents who understood British ROE were less intimidated by the SA80 than by theoretically less dangerous weapons, as David Hardy, part of a vehicle patrol from the Light Infantry, found out when attacked by a Belfast mob:

We trained our gats (SA80s) on them as we peered through our firing slots, but they knew that we wouldn’t fire live rounds at unarmed civilians. Then, they began to advance on us to try and surround us, so we had to keep our eyes to the front and rear; behind us were ginnells and alleyways from which they could sneak up on us.

There was only the one vehicle – a four man brick with a full screw in charge of us and nothing appeared to be coming to reinforce us. Then the Corporal said ‘Stick one in the chamber (of the baton gun) and stick it out of the turret.’ As soon as they saw this appear, they knew that we meant business and began to back off ... they quickly



learned that whereas we wouldn't use live ammo on them unless we knew that firearms would be used against us, they also knew that we wouldn't hesitate to use baton rounds when we were threatened. (Quoted in Wharton 2008: 389)

Four soldiers patrol the outskirts of Basra on foot during Operation *TELIC 2*, September 2003. One has a SUSAT on his weapon, while the other three have the iron sights mounted on the carrying handle and used by non-infantry units. (© IWM HQMND(SE)-03-053-009)

Operation Herrick, 2012 (overleaf)

Troops in Afghanistan could easily find themselves operating in both relatively arid desert and the lush irrigated 'green zone' along the Helmand River during a single mission, leading to a new 'Multi Terrain Pattern' camouflage replacing desert DPM from 2010. These soldiers are wearing late-pattern Osprey body armour, and the new Mk 7 helmets. Protective kneepads, 'eyeprow' protective glasses, night-vision gear and personal radios were now standard issue for all infantry, and Glock 17 pistols were issued as back-up weapons. Troops on foot patrol were usually heavily laden with armour, ammunition and water, the latter being required in large quantities when patrolling in the heat of the Afghan summer. The leader of this four-man brick has an L85A2 IW fitted with the rail interface system, 'grip pod' forward handgrip, and laser module. The second soldier has an L85A2 fitted with a 40mm L123A2 under-barrel grenade launcher (UGL). Both L85A2s are fitted with the Advanced Combat Optical Gunsight (ACOG) and Magpul polymer magazines. One of the remaining two soldiers is armed with an L108A1 Minimi LMG, which provides the brick's automatic firepower, and the other carries an L129A1 7.62mm Sharpshooter Rifle, which had taken over the role of accurate long-range shooting. By this point, the L86 LSW was not usually seen in front-line units.





Public duties

Many countries have retained older weapons for use by ceremonial guard units – the United States uses 1950s-era M14s, for example. However, the British Army has always issued troops performing public duties, such as guarding Buckingham Palace, with the current service rifle. The short, stubby design of the SA80 precluded traditional rifle-drill movements, however, since the weapon's butt would not reach the ground. This meant extensive changes to the drill manual, and a brief flurry of press excitement about the new 'Russian-style' drill movements. It also transpired that the angular edges of the SUSAT optical sight played havoc with the woollen fabric of the traditional dress tunics, and a vinyl sight cover had to be issued for weapons used for public duties. As Coldstream Guards Sergeant-Major Paul Downes notes, the SA80 was never popular for public duties:

When I first joined, we used the old SLR rifle, which was long and rested on the floor, but the SA80 we have now stays in the hand at all times. It becomes quite heavy after you've been stood still for about fifteen minutes. Hence why we have various movements: you can change arms and you're allowed to march fifteen paces to the left or right when on sentry duty, to stretch your legs and keep the blood flowing. (Quoted in Danziger 2010: 146)

Highlanders on ceremonial duties at Holyrood Palace. Note the black vinyl covers over the green plastic forestocks and SUSAT optical sights. (Cody Images)



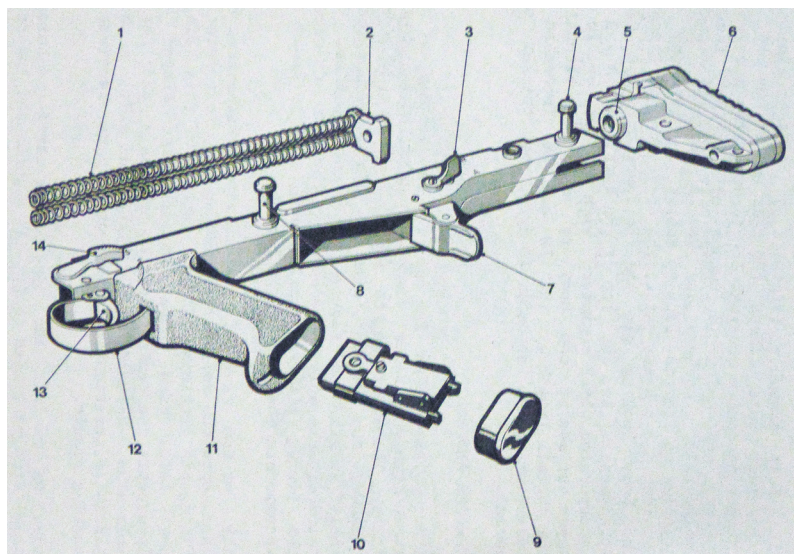
ACCESSORIES AND OTHER ITEMS

Sights

The British Army has a long tradition of marksmanship, and was the first to issue optical sights for all infantrymen, with the 4× magnification L2A2 Sight Unit, Infantry, Trilux (SUIT) fitted to late-model SLRs in the 1980s. The SA80-series weapons were intended from the outset to mount the similar L9A1 Sight Unit, Small Arms, Trilux (SUSAT) on weapons issued to front-line troops, though versions issued to rear-echelon personnel were fitted with simple iron sights for reasons of cost. It was also common to see the iron sights fitted to weapons used for jungle-warfare training, since the optical sights misted up after prolonged exposure in very humid conditions.

The SUSAT was an aluminium-bodied optical sight weighing 417g, with a 4× magnification. It used a single tapered vertical post projecting from the bottom of the sight to indicate the point of impact, rather than crosshairs. As the 'Trilux' portion of its name suggests, the sight post is marked with luminous tritium, for use in low light conditions. The low-level radioactive tritium slowly decayed over time, however, and needed to be replaced after 8–12 years. The Army was concerned about the fragility of optical sights, and the XL64 series initially had a set of folding emergency sights in a compartment in the pistol grip, to be used if the SUSAT was damaged. The emergency sights were replaced by incorporating simple emergency iron sights into the SUSAT after the NATO trials.

Although SUSAT remained standard issue, most rifles used for operational deployments to Afghanistan after 2009 were fitted with the US-made 4× tritium-illuminated Advanced Combat Optical Gunsight (ACOG), similar to that used on the M4 Carbine. Both SUSAT and ACOG sights are currently being replaced by the Canadian-made ELCAN Specter, designated as the 'Lightweight Day Sight'; this still offers 4× magnification, but runs off batteries rather than a radioactive source, and offers a weight



The British Army was initially concerned that optical sights might be too fragile for general use. This illustration from the original manual, *Instruction Manual 4.85 Weapon System*, shows how a set of back-up iron sights were to be stored in the pistol grip. (Author's Collection)

saving over the earlier units. Both the ACOG and Specter units generally have a small Close Quarter Battle (CQB) battlesight mounted above the main sight, which places a red dot on a small transparent screen. This permits faster target acquisition during close fighting, and allows the soldier to retain better peripheral vision and awareness of his surroundings.

Although the above sights have illuminated optics for shooting in low light, they are not true night sights. When the SA80 was introduced, the only night sights available were a few of the bulky 3.2kg first-generation Individual Weapon Sight (IWS). This was so heavy that it could only sensibly be used on an LSW, where the bipod took some of the weight. Night-vision technology has improved greatly during the service life of the SA80 series, however, and has become much more common. By the end of the Afghanistan conflict, the 1.2kg third-generation Common Weapon Sight (CWS), produced by Pilkington and also known as the 'Kite sight', was routinely issued down to the level of the four-man infantry brick, and thermal sights were becoming available in limited numbers at platoon level. The CWS provides the same 4× magnification as the day sights, but also intensifies available light to make a man-size target visible at 500m by starlight alone, though it generally only allows accurate shooting at distances out to 200–300m. These night-vision systems have given NATO forces a key edge over their lower-technology adversaries in recent conflicts.



The three sights fitted to SA80-series weapons: the original SUSAT (bottom), the ACOG (middle) and the new ELCAN Specter (top). A separate small Close Quarter Battle sight used for quick target acquisition is mounted above this ACOG. (Author's Collection)

Light laser modules

Several slightly different laser modules have been issued for the L85 since 2005. All have similar functionality, though the later versions are lighter and project their beams further. The LLM-01 Lightweight Laser Module is typical; as well as a white-light flashlight, it features a visible-light laser that projects a red dot onto the target, zeroed to match the point of bullet impact. This is useful for quick target acquisition or to designate a target for other soldiers. The laser will reach out to 300m, but is only really visible to around 150m, even through the rifle's optical scope. It also has an infrared laser with comparable performance, but visible only through night-vision goggles, making the beam effectively undetectable at night; and a short-range infrared 'illuminator', effectively a low-powered torch for use in conjunction with night-vision goggles. The laser modules weigh around 250g, and are Class II laser products: generally eye safe unless viewed via some form of amplifying optics, such as a telescopic sight or binoculars. A rotary switch on the top of the unit changes mode, and an additional On/Off pressure switch on the rifle's foregrip allows the user to activate the LLM-01 without having to take a hand off the weapon.

Bayonets

The 1982 Falklands War had seen British troops clearing trenches with fixed bayonets; and despite its relatively short length, the SA80 IW (though not the LSW) was always intended to take a bayonet. The first design had a tubular socket that fitted over the flash eliminator, and a short (127mm) clip-point 'Bowie knife' blade beneath. A revised design had a longer (197mm) blade, possibly to extend the 'reach' of the weapon in bayonet fighting. By the time of the troop trials, the design had shifted to a combined bayonet and utility tool. The blade was now in line with the hollow tubular handle, making it easier to use as a knife. However, since the hollow metal handle surrounded the barrel, it became red-hot after the rifle was fired, preventing the bayonet being removed until it had cooled. This design was adopted as the L3A1 bayonet.

The bayonet scabbard issued to infantrymen included a fold-out saw and a sharpening stone built into it. A clip on the plastic scabbard fitted through a slot in the blade to turn the two items into a pair of wire-cutters. Other troops received cheaper 'all arms' versions without these features.

The first millimetres of the blade tip often snapped off, and early versions sometimes had defective locking catches. These disengaged when the bayonet was stabbed into something, so that when the rifle pulled back, the bayonet was left embedded in the sandbag. The SA80's short length, though an asset in other ways, obviously limited its utility for bayonet fighting – but the training material stressed that instructors should not emphasize this. The SA80's configuration did lead to a rather unusual grip being taught, with the right hand positioned behind the butt to drive the weapon harder when thrusting downwards.

Interviewing soldiers after the First Gulf War, the LANDSET team found that 'Despite these points, infantrymen greatly valued the bayonet



SA80 bayonet and scabbard. The release catch is on the heel of the bayonet hilt, and the scabbard's saw blade is folded out. The slot in the bayonet fits onto the protrusion on the scabbard to form a wire-cutter. (Author's Collection)

... Its value in combat is as much an aid to the man behind it as much as its psychological effect on the man faced by it. LSW gunners wanted to be able to fit it on their weapons.' Although bayonets might seem old-fashioned in the modern world, the Army believes bayonet training remains useful in teaching aggression during basic training, while 'cold steel' remains a useful psychological edge when dealing with demonstrators or prisoners. Steve McLaughlin describes the bayonet training he received with The Royal Green Jackets:

Another weapon that we learned how to use effectively was the SA80 bayonet. Scarecrow-like figures would be strung up in a field, and we had to charge and scream at them, wildly slashing and stabbing at the targets with our bayonets. The instructors thought it was hilarious and would instigate competitions based around who had the best 'war-face' or the most aggressive style ...

I had always imagined a bayonet to be a slim and pointy dagger that was as light and flimsy as a kitchen knife. I was completely wrong. The SA80 bayonet is a thick slab of solid steel that is designed to punch through bones like they are made of papier mache ... one stab of the bayonet and your guts would be in a steaming pile on the floor. It is a truly frightening weapon. (McLaughlin 2007: 95)



An L85A2 IW resting on the mini-bipod extended from the vertical foregrip of the operational handguard. Although intended simply to keep weapons out of the dirt when put down, the mini-bipod could also be used to stabilize the weapon when firing. (Tom Laemlein / Armor Plate Press)

In the event, British soldiers in Afghanistan found themselves fixing bayonets with unprecedented frequency to clear compounds, and saw bayonet attacks actually being driven home.

Blank-firing attachments

The SA80 blank-firing attachment is a simple device that screws over the barrel of the rifle. It has two functions. The first is to trap propellant gas from the blank cartridge to operate the action of the rifle; otherwise, without a bullet, the gas would simply escape from the muzzle and the rifle would need manual re-cocking for each shot. The second function is to catch the bullet if a live round was somehow accidentally mixed in with blanks. The original design would stop a single round, but a fatal accident showed that it would not stop the second and third rounds of a burst. A new, stronger version of the attachment was quickly developed, capable of stopping at least three rounds, alongside a new specialized magazine for blank ammunition that could not be loaded with live rounds.

Slings

Early versions of the Enfield Weapon System came with a conventional rifle sling, or (in the case of the 'O'-series prototypes) a 'handbag style' sling that allowed the weapon to be carried under the arm ready for use. When eventually issued, however, the SA80 came with an innovative three-point sling which allowed the weapon to be carried in a number of



An L85A2 IW in Afghanistan, showing the ELCAN Specter sight and the later Surefire open-pronged flash hider. (Tom Laemlein / Armor Plate Press)

positions, including ready for use across the chest or muzzle down across the back. Later, a fastex quick-release buckle was mounted directly onto Osprey body armour. A short sling attached to the weapon's butt could be clipped to this, which prevented the weapon being lost if dropped – when the soldier switched to his back-up pistol, for instance – and let it hang muzzle down below the right arm, ready for quick use.

Rifle grenades

The SA80 IW (though not the LSW) was designed to accept NATO-standard 22mm rifle grenades, although historically the British Army had not been a great user of rifle grenades. During the First Gulf War, the L60A1 Close Assault Weapon (CLAW) rifle grenade was issued. It came in a pouch containing two grenades and a simple plastic sight; the latter clipped onto the side of the normal SUSAT sight, and had three range settings of 75m, 100m and 125m. The grenade itself slid over the flash hider, and was launched out to a maximum range of 125m by a standard



live round. The 40mm-diameter warhead combined a hollow charge (to deal with light armour) with a fragmentation effect. A number of incidents of accidental premature detonation led to the L60A1's withdrawal from service after the war, however.

The L123A2 under-barrel grenade launcher

The British Army was surprisingly slow to adopt 40mm grenade launchers, although the SAS made use of second-generation M203 launchers fitted below the barrels of their M16s. One feasibility study prototype mounted a 40mm under-barrel grenade launcher (UGL), which even had the advantage of opening to the side for loading, unlike the M203 which slid forward on rails and was thus unable to handle longer 40mm rounds. This did not enter service, however. A Heckler & Koch-designed 40mm UGL was issued from 2002, replacing the front handguard of the rifle. It is a single-shot weapon, aimed with a sight unit that clips onto the side of the rifle and fires from its own separate trigger. Like the earlier prototype, it

L60A1 Close Assault Weapon (CLAW) rifle grenades simply slid over the flash hider, and were aimed using a simple plastic sight which clipped to the side of the SUSAT optical sight. The blue round is a training version of the anti-personnel grenade, while the green round is the high-explosive/shaped-charge grenade. Both were launched using standard live rounds. (Author's Collection)

An L85A2 with an L123A1 under-barrel grenade launcher; the breech swings sideways (towards the camera) for reloading. Below the weapon is an inert 40mm drill round. The L85A2 is fitted with an ACOG sight and Magpul polymer magazine. (Author's Collection)



Developing a 40mm under-barrel grenade launcher for the L85 involved a surprising number of false starts. From the bottom upwards: a 40mm grenade launcher on a 'Double O'-series prototype; an M203 grenade launcher on an L85A1; a Royal Ordnance ENCAW (Enfield Close Assault Weapon) grenade launcher on an L85A1; and an L123A1 under-barrel grenade launcher on an L85A1. Note that the middle two L85A1s have damaged or missing butt plates. (Author's photograph, © Royal Armouries PR.5347, PR.9222, PR.8759, PR.9230)



is reloaded by swinging the barrel out sideways and loading a new round from the rear, with the same advantages over the M203. The L123A2 can launch grenades out to 350m, either in a direct trajectory or an indirect one that lobbs them over intervening cover. Typically, one launcher is issued to each four-man infantry brick, adding a useful capability to the infantry section's firepower.

The launcher itself weighs 1.5kg, but a load of 12 40mm grenades adds another 2.7kg – a significant addition on top of the rifle and its ammunition. It can fire the full range of NATO-standard low-velocity 40×46mm grenades, but only high-explosive and practice rounds are currently issued. Buckshot rounds (for close fighting) and non-lethal baton rounds have been postulated as potential future developments to enhance the launcher's capabilities. Other potential future improvements include an enhanced aiming module to enable better indirect fire, and a longer-cased medium-velocity round to extend the weapon's range.



IMPACT

The verdict of battle

TACTICAL IMPACT

Changes in organization

Until the SA80 was adopted in 1985, British infantry-platoon organization was essentially unchanged from World War II, with a very small platoon HQ plus three eight-man rifle sections. Each section (led by a corporal) was built around a three-man GPMG team under a lance corporal, plus five riflemen with SLRs. The arrival of the SA80 changed this. Each section was now broken down into two equal four-man bricks, each containing three riflemen with L85 IWs plus an L86 LSW gunner. Meanwhile, the platoon HQ was enlarged to include a single GPMG (SF) on a tripod for sustained-fire support. After the invasion of Iraq in 2003, new weapons were added so each brick ideally had one L85, one L85 with UGL, one Minimi as the primary automatic weapon and an LSW, which was retained in a 'heavy rifle' role for accurate long-range shooting.

In Afghanistan, changing tactical requirements meant the section was often replaced by the 'multiple', essentially a half-platoon typically made up of three four-man bricks. Meanwhile, some bricks received the L129A1 7.62mm semi-automatic Sharpshooter Rifle to take over from the LSW in the long-range fire role, or became 'heavy' bricks with two Minimis.

Changes in weapons deployed

The SA80 family was intended to replace four weapons: the L1A1 SLR, the Sterling SMG, the L4A4 LMG and the L7A1 GPMG in the 'light' role,

i.e. all except those used in a dedicated sustained-fire role or as a vehicle-mounted weapon. The L85 was a significant improvement over the (effectively obsolete) 9mm Sterling, offering much better range and lethality, while being almost as compact and not much heavier. It also took one type of ammunition out of the platoon supply chain completely. The L85 provided direct replacements for the ageing SLRs. While some preferred the older weapon, it is worth recalling that although policy still prevented women serving in the infantry, the Iraq and Afghanistan conflicts saw female soldiers serving in front-line roles as medics, search-dog handlers, etc. While these women were able to handle the L85 without difficulty – and the press made a certain amount of fuss when the first insurgent was killed by a female soldier using the weapon – it is unlikely that most would have been able to use the larger SLR. The L85 was also much easier for rear-echelon personnel such as drivers to carry in the course of their duties, and the non-linear nature of recent conflicts made it more likely that such personnel would need to defend themselves.

The range and hitting power of the GPMG saw it return to regular infantry use in Afghanistan, despite its weight. (Tom Laemlein / Armor Plate Press)

The L4A4 LMG – effectively the old World War II Bren gun re-barrelled for 7.62mm ammunition – was only retained in limited roles: generally where the mobility of a box-fed machine gun was more important than weight of fire. The LSW took over this role adequately, though the Minimi performed better and ultimately displaced the LSW in

turn. It is fair to say that the LSW failed as a replacement for the GPMG. With its lighter calibre and with its sustained-fire capability compromised by the lack of a belt feed or quick-change barrel, it was never able to lay down the weight of fire required. Some units – such as The Parachute Regiment – simply retained their GPMGs, while units that had given them up re-acquired them. The adoption of the Minimi went a good way to improve the situation, but infantry units could still be seen lugging GPMGs on foot patrols in Afghanistan, despite the greater weight of the gun and its ammunition. Indeed, the Afghan conflict even saw some units forming specialist ‘fire support groups’ with multiple GPMGs, recreating the old-style battalion machine-gun platoon.

Overall, the British Army found itself with as many



different weapons as it started with. The only real disappearance was that of the 9mm SMG, which virtually no other country still deployed as a front-line weapon anyway.

Accuracy

The SA80's accuracy is one of its greatest strengths, especially with the SUSAT optical sight fitted. The MoD stated that the L85A1 was 20 per cent more accurate than the SLR it replaced, with the latter usually regarded as a reasonably accurate weapon. The MoD routinely used the most flattering data for comparisons, however, and it is likely that the comparison was between an iron-sighted SLR and an L85A1 fitted with the SUSAT, in which case much of the improvement should probably be attributed to the sight unit rather than the rifle. According to the Defence Select Committee report, pass rates for the Annual Personal Weapon test during troop trials rose from 72 per cent for troops armed with the SLR to 100 per cent for troops armed with the SA80, while the proportion scoring highly enough to achieve marksman standard rose from 8 per cent to 50 per cent.

Even without the SUSAT optical sight, the L85 has a full-length barrel despite its compact size, making it significantly more accurate than shorter-barrelled rivals such as the AK-47 or the US M4 Carbine. This was even more notable for the LSW, where the extended barrel and bipod gave it better accuracy and range than any assault rifle, and it enjoyed a brief period of use as a 'dedicated marksman' rifle even after its poor sustained-fire capability led to it being replaced in the light support role.

The British Army has long preferred careful aimed fire over the US use of automatic fire as a default, let alone what it has often disparagingly referred to as the 'spray and pray' shooting of opponents such as the Taliban. While automatic fire is extremely useful in certain circumstances – such as reacting to an ambush – it is inevitably less accurate than aimed single shots, and British training discourages its use in most situations. Sergeant Dan Mills of The Princess of Wales's Royal Regiment noted 'fully automatic ... would be used only very rarely, for in-your-face tasks like trench clearing. It's very hard to aim on fully automatic because of the recoil. On single shot, a soldier is expected to hit a target at 300 metres. But you're a pretty good shot if you can hit something more than 600 metres away' (Mills 2007: 40).

The later upgraded laser module (LLM-03) mounted on an SA80A2. As with the older LLM-01, it can be activated by a cable-mounted switch on the grip pod, as well as the conventional switches on the rear of the module. (MOD © Crown copyright 2014)



THE L85 VERSUS OTHER ASSAULT RIFLES					
WEAPON	CALIBRE	FEED	WEIGHT*	BARREL LENGTH	OVERALL LENGTH
L85A2 with SUSAT	5.56×45mm	30-round box	4.13kg**	518mm	780mm
L22 Carbine with SUSAT	5.56×45mm	30-round box	3.86kg	442mm	709mm
SLR	7.62×51mm	20-round box	4.34kg	554mm	1,143mm
AKM	7.62×39mm	30-round box	3.14kg	415mm	870mm
AK-74	7.45×39mm	30-round box	3.30kg	415mm	943mm
M16A2	5.56×45mm	30-round box	3.77kg	508mm	1,006mm
M4 Carbine with ACOG	5.56×45mm	30-round box	2.88kg	370mm	838mm†
FAMAS F1	5.56×45mm	25-round box††	3.60kg	488mm	757mm
Galil AR	5.56×45mm	35-round box	3.95kg	460mm	979mm‡
* Unloaded. ** 3.82kg without SUSAT. † 757mm with stock collapsed. †† Later versions accept 30-round STANAG box magazines. ‡ 742mm with stock folded.					

THE L86 VERSUS OTHER SAWS						
WEAPON	CALIBRE	FEED	WEIGHT*	BARREL LENGTH	OVERALL LENGTH	RATE OF FIRE
L86	5.56×45mm	30-round box	5.40kg	646mm	900mm	600–750rds/min
L7 GPMG	7.62×51mm	Belt	10.90kg	597mm	1,232mm	700–1,000rds/min
L4A4 Bren	7.62×51mm	30-round box**	8.68kg	635mm	1,156mm	520rds/min
M60	7.62×51mm	Belt	10.40kg	560mm	1,067mm	550rds/min
FN Minimi	5.56×45mm	Belt†	7.10kg	405mm	1,040mm	750–1,000rds/min
RPK	7.62×39mm	75-round drum††	4.80kg	590mm	1,040mm	600rds/min
Negev	5.56×45mm	Belt†	7.40kg	460mm	1,020mm	850–1,100rds/min
* Unloaded. ** Also accepted the 20-round SLR magazine. † Also accepted 30-round STANAG box magazines. †† Also accepted the 30-round AKM box magazine or 40-round extended box.						

Hitting power

The hitting power of the SA80 is often compared unfavourably to that of the 7.62mm SLR, especially by ‘armchair critic’ firearms enthusiasts. In mathematical terms, the 5.56mm SS109 cartridge fires a 4g bullet at 940m/sec, giving around 1,770 joules of energy at the muzzle. Meanwhile, a 7.62×51mm round fires a 9.3g bullet at 840m/sec, giving muzzle energy of around 3,300 joules, almost twice as much. This doesn’t automatically mean that the larger round is twice as lethal, however.

First, repeated studies show the most important factor in wound severity is shot placement – essentially, whether you hit your target in the head or the leg is far more important than the calibre of the bullet.

Secondly, there is considerable difference between the raw muzzle energy that a weapon produces, and how much of that energy is transferred to the target – the so called ‘energy dump’. When a high-velocity bullet hits

a person, it will generally pass completely through the body unless it hits a major bone, creating a second (exit) wound on the opposite side from the entry wound. Since any energy the bullet still has when it leaves the body is wasted – a so-called ‘shoot through’ – higher impact energy doesn’t automatically translate into higher energy dump. A theoretically ‘perfect’ bullet would fragment inside the target, breaking into multiple small pieces which would decelerate swiftly and release all their energy within the body; but ‘explosive’ or ‘dum-dum’ bullets designed to do exactly this have long been outlawed as inhumane. In practice, rifle rounds tend to destabilize and tumble when the pointed nose hits flesh and starts



A female dog handler from the Theatre Military Working Dog Support Unit in Afghanistan, 2011. More women in combat on the front lines increased the need for weapons they could handle to defend themselves. (Tom Laemlein / Armor Plate Press)

to decelerate, giving up more energy and often inflicting terrible wounds as they slice side-on through tissue matter. Although many people associate this with the 5.56mm round in particular, it actually occurs with all high-velocity rifle rounds, since most of the weight of these pointed rounds is towards the rear, making them inherently unstable when they strike. Ballistics is rarely as clear-cut as sometimes portrayed, but all the evidence indicates that both the 5.56mm round and the 7.62mm round reliably deliver enough energy to inflict lethal wounds out to 400m. For comparison, a .45 ACP round fired from a Colt 1911 pistol – often regarded as a ‘man-stopping’ round – delivers around 500 joules, less than one-third that of a 5.56mm round.

Finally, the SA80 has the capability for automatic fire while the SLR does not. This makes any discussion of single-round lethality a moot point because a three-round burst of 5.56mm will deliver more energy into the victim than a single round of 7.62mm.

The 5.56mm round was clearly inferior to its predecessor in two aspects, however. First, the 5.56mm round is good out to around 400m; beyond that, the 7.62mm carries better due to its heavier bullet, in the same way that you can throw a golf ball further than a table tennis ball. Although hits out to 600–700m with the L85 did occur, they were exceptional. In fairness, this was a design parameter of the weapon, and it was rare for infantrymen to be able to see and identify targets at such distances.

Secondly, the lighter rounds didn’t penetrate hard cover well, be it the concrete apartment blocks encountered in Iraq, or the thick mud-brick walls of Afghan compounds. Colonel Tim Collins remembers:

Rounds (L to R): the Soviet 7.62×39mm round used by the AK-47/AKM series; the 5.56×45mm round used by the SA80 and M16/M4 family; and the 7.62×51mm NATO round used by the SLR and GPMG. The indentations in the sides of the two NATO cartridges identify them as inert drill rounds. (Author’s Collection)



I ordered the companies to begin to train at an abandoned Iraqi army barracks outside the town. We planned to perfect our house-to-house fighting there and to test our weapon systems against the buildings, which were typical of the region. We found that the 5.56mm rounds had little effect, nor did the Iraqi 7.62mm (short), fired from their AK47s. However, the 7.62mm from our GPMGs ate their way straight through the buildings, and the .5 inch heavy machine gun punched fist-sized holes through the walls. A burst of five to seven rounds could blast a hole big enough for a man to climb through. (Collins 2005: 226)

The troops' verdict

Although the SA80 attracted a great deal of criticism in the press, the most important opinions are those of the men who actually had to carry and use it. The SLR was popular with soldiers, and it is fair to say that many did not regard the L85 as a worthy replacement in its early days. Former SAS soldier Chris Ryan's opinion was that 'SA80s are poor-quality, unreliable weapons at the best of times, prone to stoppages, and it seemed pretty tough to have to rely on them' (Ryan 2011: 54–55). SAS Sergeant Andy McNab compared the SA80 to the US M16:

The regiment tried SA80s in jungle training when they came out, and found it not best suited to its requirements. With the M16 everything's nice and clean, there are no little bits and pieces sticking out. The safety-catch is very simple and can be operated with the thumb – with the SA80 you have to use your trigger finger, which is madness. If you're in close country with the M16, you can flick the safety-catch off easily with your thumb, and your finger is still on the trigger ... If rifles were cars, instead of going for a Ford Sierra 4×4 – good, reliable, tested and enjoyed by the people who drive them – in the SA80 the Army went for a Roll-Royce. But at the stage when it was first brought into service, it was still a prototype Rolls-Royce, and there were plenty of teething problems. (McNab 1993: 75)

It is worth noting that while the SAS do not use the SA80, they did not use its predecessor, the SLR, either. McNab was not the only one to think the M16 was a better weapon, however. The first time Rifleman Steve McLaughlin handled an M16,

A paratrooper in Iraq in 2003. The green plastic furniture of his L85 has been camouflage-painted. He has a desert-camouflage frog (cover) for his bayonet sheath, which has a field dressing taped to it. (Tom Laemlein / Armor Plate Press)



An L85A2 with UGL, Afghanistan.
Note the magazine-loading tool
tucked into the webbing on the
front of the ammunition pouch.
(Tom Laemlein / Armor Plate
Press)



I could instantly see why it was rated as a better weapon than the SA80. The M16 was significantly lighter, much simpler to use and a hell of a lot easier to clean and maintain ... A case could be argued for the SA80 having greater killing power and a superior sighting system, but the ultimate decider of a general assault rifle is its ease of use and reliability – and on that count, the M16 wins hands down. (McLaughlin 2007: 134)

The protracted reliability problems meant British troops were armed for a decade or more with a weapon they had little confidence in. This was a very poor situation and would have affected morale in almost any army, while many felt the MoD ‘quick fix’ solutions weren’t getting to the root of the problem. The situation only really began to improve with the A2 upgrade. Sergeant Dan Mills commented:

Forget what you’ve heard, the SA80 A2 variant was a perfectly reliable and good weapon. Its predecessor, the A1, got all the bad headlines and was a bit suspect. But its German manufacturers Heckler and Koch had done a lot of work to iron out the faults. The A2 had a sturdier cocking handle and a decent ejection mechanism that no longer threw the old shells back inside the rifle to cause stoppages. (Mills 2007: 40)

Royal Marine Jake Olafsen also thought the A2 upgrade had solved the weapon’s problems:

Most British forces use the SA-80... When originally issued it was a temperamental bit of kit. Magazines would fall off or a bit of dirt

would cause stoppages. But Heckler & Koch, the German firearm makers, got their hands on it and made some changes and the latest model has proved to be very reliable. The more I used it the more I liked it. (Olafsen 2011: 20)

His fellow Royal Marine Matt Croucher went further, describing the SA80 as ‘a brilliant weapon as long as you keep her clean’ (Croucher 2009: 210).

BEYOND THE BATTLEFIELD

How much did the SA80 cost?

Cost reduction was originally perceived to be a key advantage of switching to the SA80 system, since the new weapons would be made from cheap stamped components, rather than expensively machined parts like the SLR and GPMG. When originally proposed in 1978, the SA80 series was expected to cost £150 for an IW and £170 for an LSW, excluding the cost of the SUSAT optical sight. This compared very favourably with a quoted price of £350 for an SLR and £2,362 for a GPMG. By the time the rifle prices were fixed in 1983/84, however, the prices had risen to £203 for the L85A1 IW, £320 for the L86A1 LSW and £135 for the SUSAT and its bracket. (The equivalent 2015 values, inflated using the Retail Prices Index, are £612 (\$930) for the L85A1, £964 (\$1,465) for the L86A1 and £407 (\$619) for the SUSAT and its bracket.)

The Heckler & Koch upgrade to SA80A2 standard cost around £92 million, or £460 per weapon in 2000. Added to the original cost and adjusting for inflation, this suggests that the total 2015 equivalent cost for an upgraded L85A2 would be around £1,300 (\$1,980) without the SUSAT or ACOG sight units, rail interface upgrade or laser module. For comparison, the US Government paid \$800–\$1,200 for each M4 Carbine, depending on contract, excluding the ACOG sight.

Manufacturing the SA80

The SA80 was originally produced at RSAF Enfield in London, a government-owned factory which had produced weapons for the Army since 1816. Production of the first tranche of 175,000 weapons began in June 1985, although this was complicated by numerous small modifications necessary to fix problems emerging from the user testing, which was still going on.

The SA80-series weapons were largely made from components stamped out of sheet metal in hydraulic presses, as a way of cutting costs compared to the SLR and GPMG. Production of the latter weapons used many components machined from solid material, which produced strong components to close tolerances, but was an expensive and time consuming process. RSAF Enfield had produced weapons using stampings before, but

these had been simple weapons like the Sten SMG, with relatively lax tolerances. They now discovered that producing stamped components to the tighter tolerances required for the SA80 was more difficult than expected, resulting in production delays and higher-than-expected wastage.

Meanwhile, the British government wished to privatize the whole Royal Ordnance group, including RSAF Enfield, in line with the Conservative Party's belief that many state-owned assets, such as the railways, coal mines and telephone companies, would be run more efficiently by private enterprise. Obviously, such a sell-off would be much easier, and achieve a higher price, if Royal Ordnance had a full order book. Most people were not surprised, therefore, when Royal Ordnance was awarded the contract to manufacture the second tranche of SA80 weapons in 1987, despite the various issues that had emerged. In fact, British Aerospace (BAe) – which had purchased Royal Ordnance, including RSAF Enfield – found itself unsure as to whether it actually wanted to proceed with the second tranche. Problems with manufacturing and quality control meant that the agreed contract price was actually less than the weapons were costing to produce. BAe decided to close the Enfield factory, having concluded that the working practices were old-fashioned and the workforce inflexible. Production would move to a new £15 million factory in Nottingham, which would produce the weapons at a lower unit cost by using the most up-to-date manufacturing and management techniques. As a bonus, the Enfield site could then be sold for redevelopment, realizing a considerable profit for BAe. Production at Enfield ended in September 1988. Bitter at the impending redundancies, one of the staff commented: 'Having been shafted by BAe and our own management, we thought why the hell should we care if [the SA80] worked or not. All we wanted to do was see the last of the bloody things and leave' (quoted in Raw 2003: 161–62). Such attitudes are unlikely to have helped resolve the existing quality-control issues.

Meanwhile, the new factory at Nottingham was having its own problems. Few of its staff had previous experience of firearms manufacture, since management felt that it was little different to working on any other production line. Production of most components was outsourced to subcontractors, with only 15–20 components being made in-house, compared to 230 at Enfield. While this kept costs down, it caused significant teething troubles when combined with the then-fashionable 'just in time' manufacturing techniques used. If components from a subcontractor were delayed or did not meet the required tolerances, the production line had to be halted as the plant kept very low levels of component stock.

Production at Nottingham ended in 1994, after around 330,000 SA80 weapons had been made, with 95 per cent being L85A1 IWs. The production line was broken up when the hoped-for export sales did not materialize, thus ending any possibility of further production. The site closed in 2001, and was sold off for a retail development. Residual work on the SA80 passed to Heckler & Koch in Germany, itself then a subsidiary of the British BAE Systems Group.

Export sales

Britain has a strong history of exporting arms, especially to current and former Commonwealth countries and to the Gulf States, with which it has long-established links. Royal Ordnance produced brochures and manuals for the SA80 system in French, German, Spanish and Arabic when the weapon first appeared, in expectation of strong export sales. In fact, very limited numbers were sold or provided as military aid to Bolivia, Jamaica, Mozambique, Nepal, Sierra Leone and Zimbabwe. Meanwhile, the relatively restrictive gun laws in Britain limited the domestic market for a 'civilianized' semi-automatic-only version, and only a few of the latter were sold.

The MoD rejected the embarrassing implication that poor export sales reflected badly on the weapon by implying that the SA80 was 'an extremely sophisticated' weapon that was effectively too advanced for most potential purchasers such as the Gulf States. This rather failed to explain, however, why those same nations were often buying British tanks and missile systems at the same time, exactly because of their sophistication. Since the SA80 had failed to achieve any significant further sales by the time the order for the British Army was completed in 1994, the Nottingham production line was broken up, meaning no further examples would be available. This meant that the SA80 could not take part in the exercise to select a new 5.56mm rifle for British police firearms units in the 1990s, leaving the field open to the Heckler & Koch HK G36. The MoD Police are thus the only British police force to adopt the SA80, using weapons bought as part of the production for the British armed forces.



A soldier with an L85A2 fitted with a UGL during urban training in Kuwait. (Cody Images)

THE FUTURE FOR THE SA80

All weapons have a limited service life – even those that are not overtaken by the march of technology. Barrels wear out, components break, and stocks of spare parts – no matter how large – eventually run out. The clock began ticking for the SA80 once the Nottingham production line closed in 1994. The 330,000 units produced were originally expected to

last the Army around 20–25 years, with procurement of a replacement beginning around 2005. The end of the Cold War meant the British Army roughly halved in size in the 25 years after the SA80's adoption, however. This significantly extended the SA80's expected service life, as it created a large stock of spare weapons which could be stripped for parts.

In 2006, the MoD indicated that it expected the SA80 to remain in service until 2020, although the procurement process would start earlier in order to have a replacement in service by that time. The MoD therefore requested tenders for a new Modular Assault Rifle System (MARS) in 2012, expecting the first weapons to be in service by 2014 and general issue in 2020. The specification was for a straightforward 5.56mm assault rifle, and the timescales effectively limited entries to weapons already available 'off the shelf', rather than anything developed to order. The replacement project was cancelled in 2014/15, however, in favour of using 3D printing technology to produce new replacement parts – notably the trigger mechanism housing (lower body), this being a stamped component which could not otherwise be economically produced in small volumes. Such components are not cheap – the 3D printers are million-pound industrial units using titanium oxide, rather than office models, and are printing individual components, rather than complete weapons – but the process has potentially eliminated shortages of critical spares for the foreseeable future.

In the meantime, the SA80 will form the base weapon for the Future Integrated Soldier Technology (FIST) programme. This will deliver various improvements, starting with lightening the weapon by using replacement components made from carbon fibre and titanium. Possible further enhancements include an improved UGL sight module, full-length top rails to enable optics to be swapped out quickly, and powered rails which would allow all the devices on the rifle (along with the soldier's radio and night-vision aids) to be powered from a central power pack, thus saving weight over each device having individual batteries. More speculative ideas include a weapon-mounted camera linked to a helmet-mounted sight unit, which would allow soldiers to deliver aimed fire around corners and over cover without exposing themselves, and longer, higher-velocity rounds to extend the range of the UGL.



An L85A2 with a 3D-printed trigger mechanism housing below a standard L85A1. (Author's Collection)



CONCLUSION

The SA80 concept had some interesting technical ideas, and succeeded in getting a full-length rifle barrel into an extremely compact weapon. Some of the criticism of it has been unfair. Complaints regarding its hitting power, in particular, have tended to cherry-pick the things the previous 7.62×51mm round did well, while glossing over its disadvantages. Had a few things happened differently – if the MoD hadn't cancelled the left-handed conversion kit, and had acted more promptly in addressing the initial issues with the weapon, instead of denying there was a problem for more than a decade – then the L85 might have given solid service as a rifle, with its early 'teething troubles' forgotten like those of the M16. 'Might-have-beens' are exactly that, however, and the reality is that the weapon was – and remains – tainted by a reputation for poor reliability that overrides any appreciation of its real virtues.

The procurement process for the SA80 was opaque and apparently dominated first by a concern with 'buying British' rather than 'buying the best', then by an unwillingness to admit previous mistakes. Ironically, the high cost of fixing the problems that were a consequence of the corner-cutting undertaken to keep the original price down meant that the SA80 ultimately proved more expensive than any of its competitors. Even the Defence Select Committee report (1993) expressed the view that the SA80 'was delivered late, and had many defects that in our view should have been detected and put right before it entered service' and that the MoD took far too long to address and resolve the weapon's initial flaws.

The LSW looked like a good idea on paper, and had it been issued as a 'heavy automatic rifle' to supplement the GPMG in each section, it might have been well received; but it was too compromised by the need to maintain commonality with the rifle to really be a capable replacement for the GPMG, leaving it as a weapon without a role.



A Royal Navy guard of honour with L85A2 rifles fitted with black vinyl parade covers and polymer magazines at HM Naval Base Devonport in 2015. (Photo by Max Mumby/Indigo/Getty Images)

Despite its significant initial flaws, the L85 gave decent service once these were finally resolved. It has now been the British Army's primary rifle for more than three decades, and few serving soldiers can remember anything else. More importantly, those years have seen the Army involved in the heaviest fighting it has experienced since the Korean War in the early 1950s, with a decade of more or less continuous combat operations in Iraq and Afghanistan. Although it is likely to remain in service for another decade at least, the SA80 is almost certain to be the last wholly British-produced rifle purchased and used by Britain's armed forces.

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